APPENDICES

APPENDICES TABLES

APPENDICES FIGURES

A   Appendix A: NAS Communication Hierarchical Diagrams

Appendix A contains the functional analysis of the NAS Communication System presented as a series of figures. The functional analysis was used to structure both the safety and security analyses. The "C" preceding all of the numerical functional levels is used to represent "communication" – shorthand for the NAS Communication System.
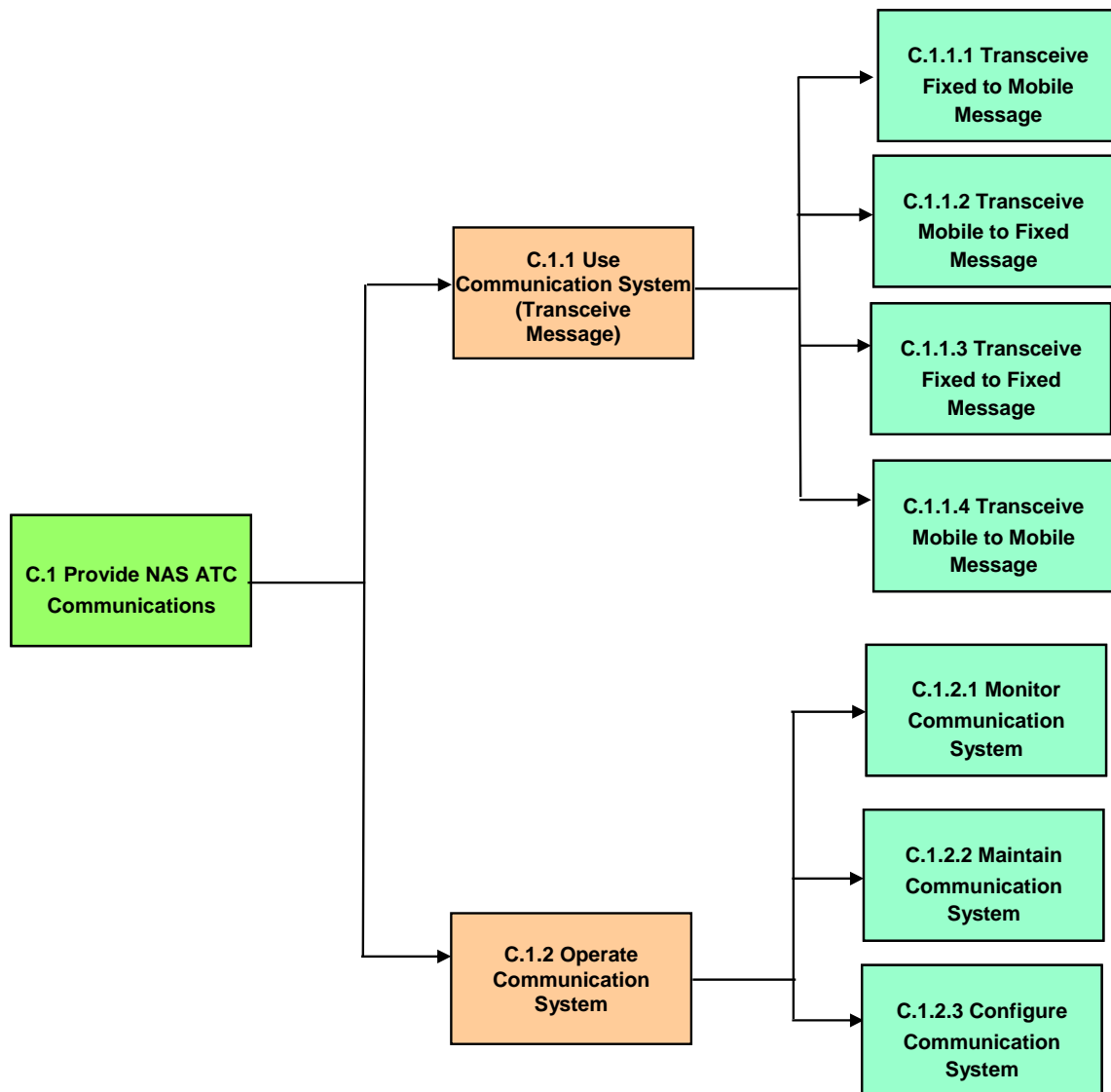
Figure A-1:   NAS Communication System High Level
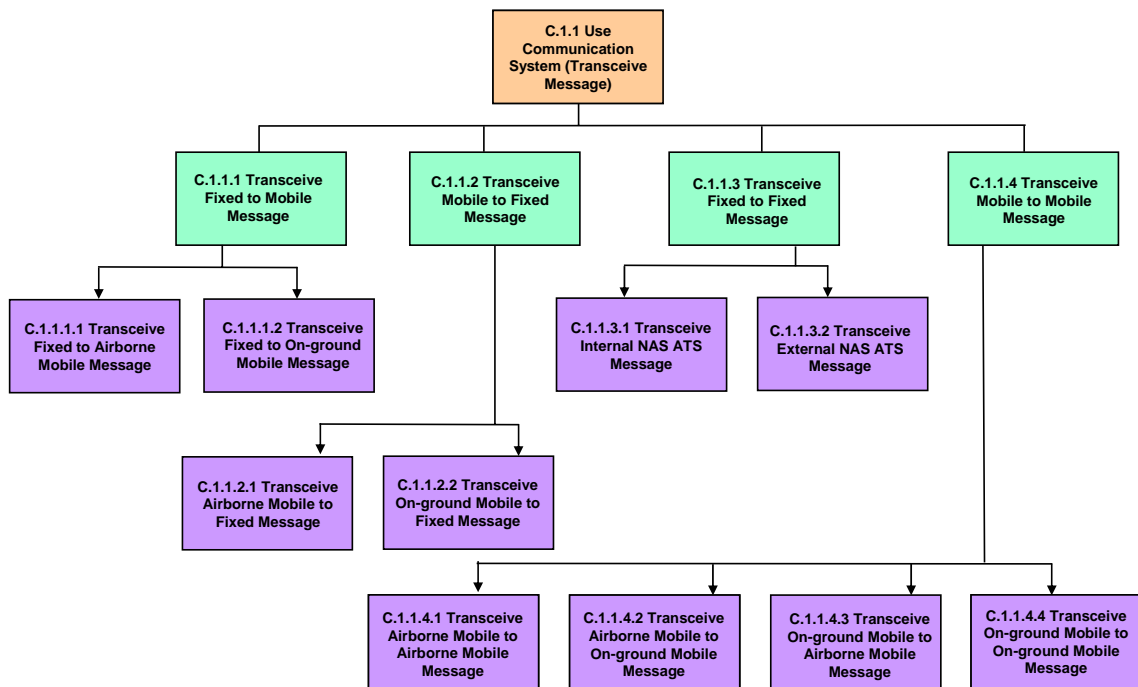
Figure A-2:   Decomposition of C.1.1: Use Communication System (Transceive Message)
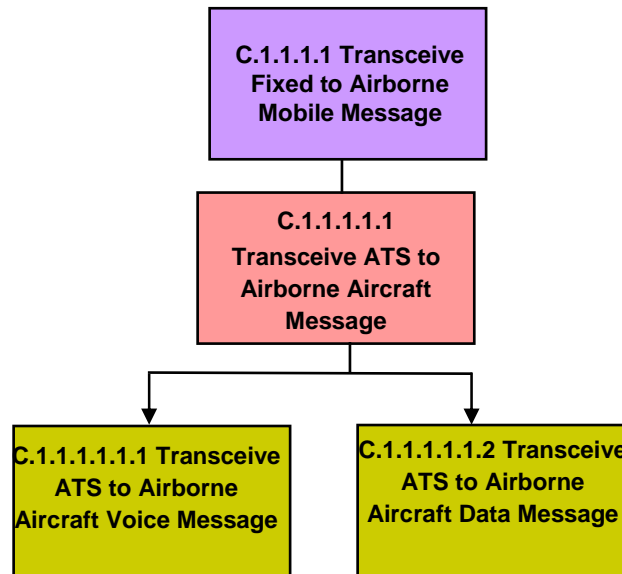
Figure A-3:   Decomposition of C.1.1.1.1: Transceive Fixed to Airborne Mobile Message
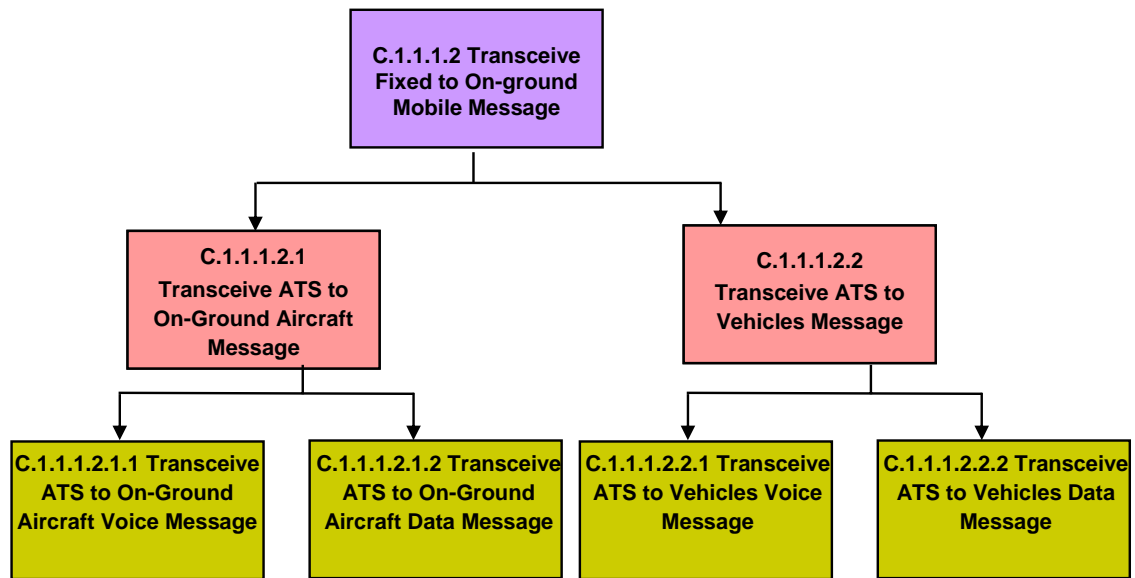
Figure A-4:   Decomposition of C.1.1.1.2: Transceive Fixed to On-Ground Mobile Message
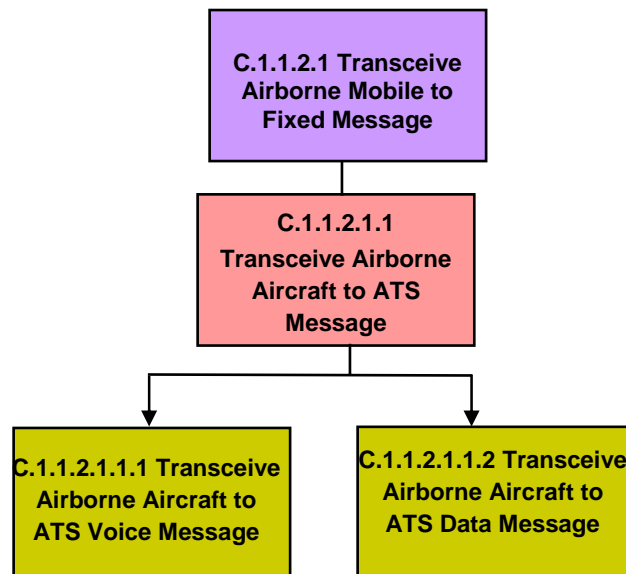
Figure A-5:   Decomposition of C.1.1.3.1: Transceive Airborne Mobile to Fixed Message

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                    ┌─────────────────────┐
                    │ C.1.1.2.2 Transceive│
                    │ On-ground Mobile to │
                    │   Fixed Message     │
                    └─────────────────────┘
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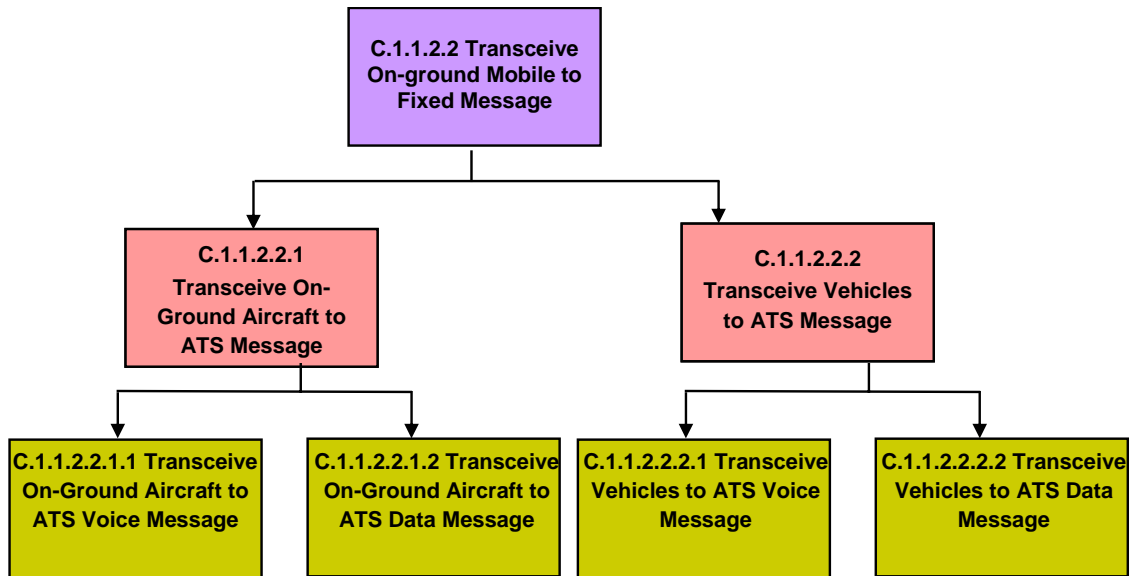
Figure A-6:   Decomposition of C.1.1.2.2: Transceive On-Ground Mobile to Fixed Message

C.1.1.2.2.1 Transceive On-Ground Aircraft to ATS Message

C.1.1.2.2.2 Transceive Vehicles to ATS Message

C.1.1.2.2.1.1 Transceive On-Ground Aircraft to ATS Voice Message

C.1.1.2.2.1.2 Transceive On-Ground Aircraft to ATS Data Message

C.1.1.2.2.2.1 Transceive Vehicles to ATS Voice Message

C.1.1.2.2.2.2 Transceive Vehicles to ATS Data Message
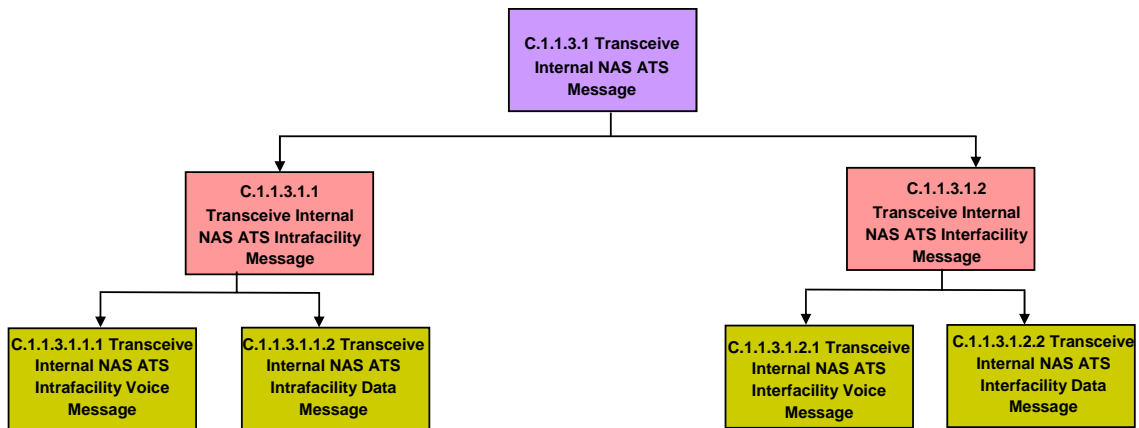
Figure A-7:   Decomposition of C.1.1.3.1: Transceive Internal NAS ATS Message

C.1.1.3.1 Transceive Internal NAS ATS Message

C.1.1.3.1.1 Transceive Internal NAS ATS Intrafacility Message

C.1.1.3.1.2 Transceive Internal NAS ATS Interfacility Message

C.1.1.3.1.1.1 Transceive Internal NAS ATS Intrafacility Voice Message

C.1.1.3.1.1.2 Transceive Internal NAS ATS Intrafacility Data Message

C.1.1.3.1.2.1 Transceive Internal NAS ATS Interfacility Voice Message

C.1.1.3.1.2.2 Transceive Internal NAS ATS Interfacility Data Message

Figure A-8:   Decomposition of C.1.1.3.2: Transceive External NAS ATS Message
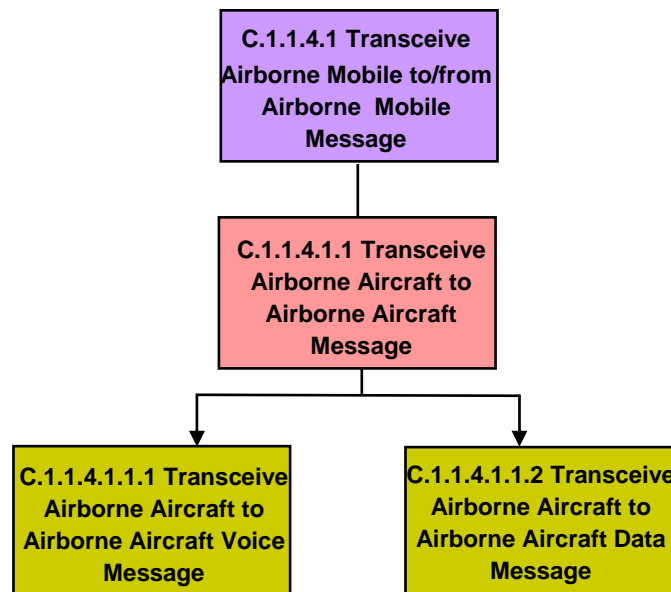
Figure A-9:   Decomposition of C.1.1.4.1: Transceive Airborne Mobile to Airborne Mobile Message
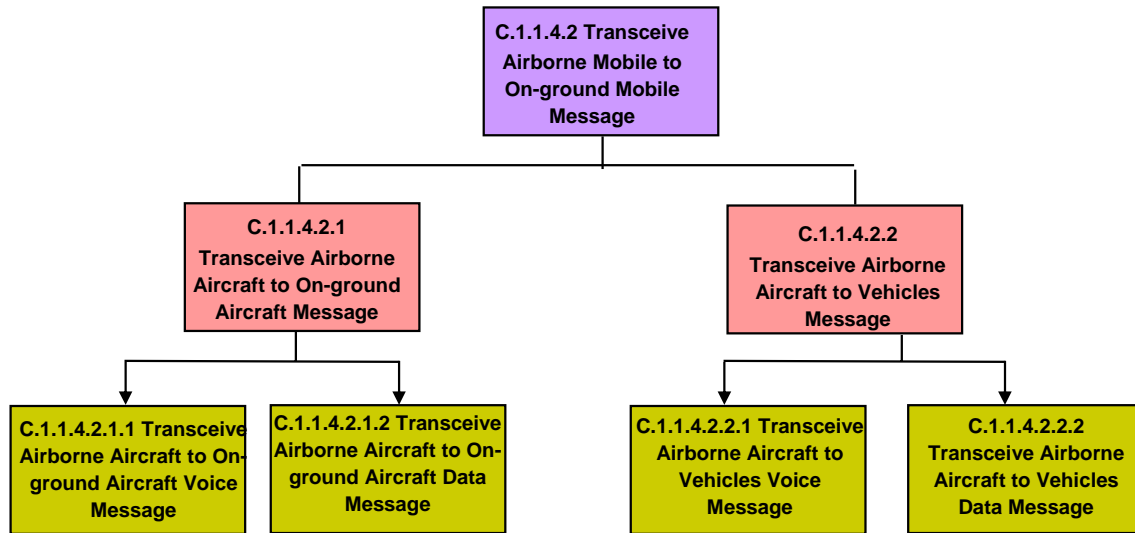
Figure A-10: Decomposition of C.1.1.4.2: Transceive Airborne Mobile to On-ground Mobile Message
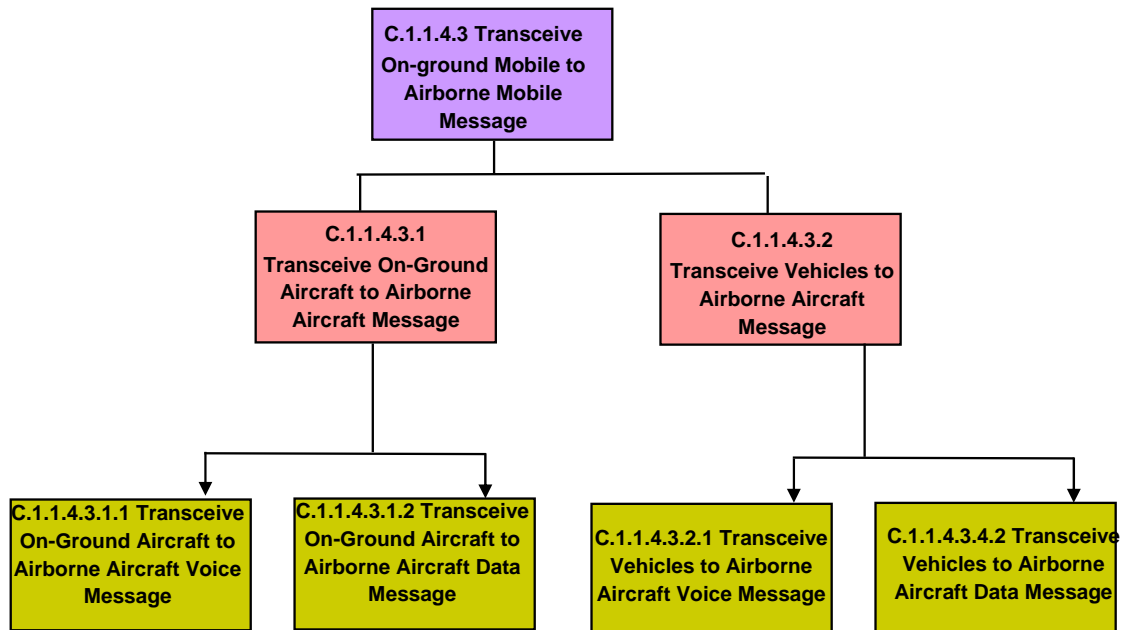
Figure A-11: Decomposition of C.1.1.4.3: Transceive On-ground Mobile to Airborne Mobile Message
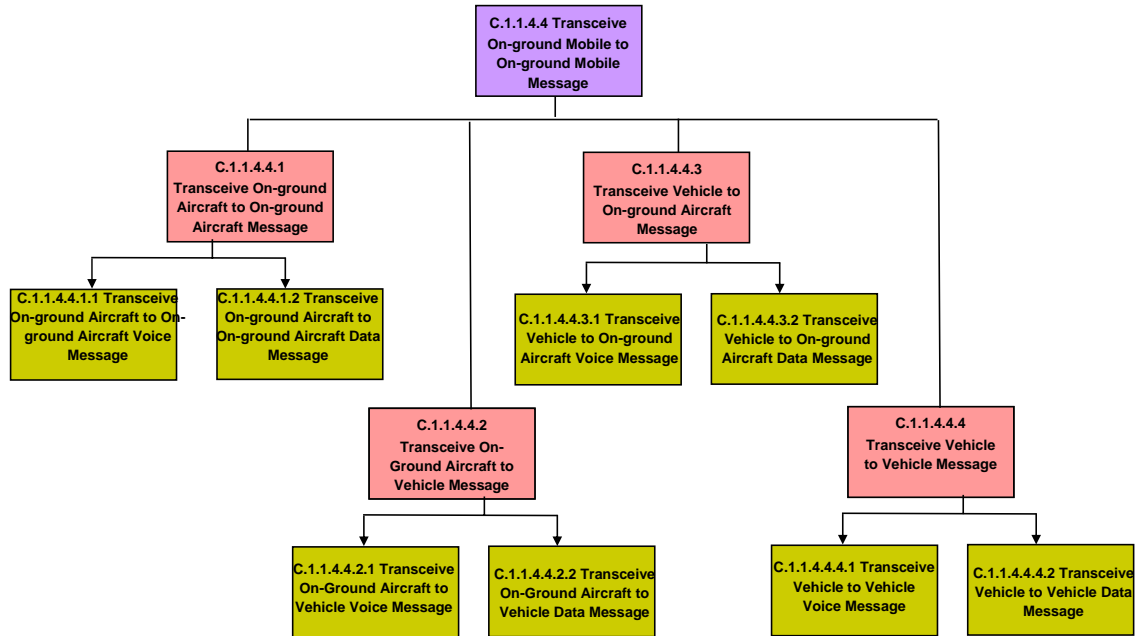
Figure A-12: Decomposition of C.1.1.4.4: Transceive On-ground Mobile to On-ground Mobile Message
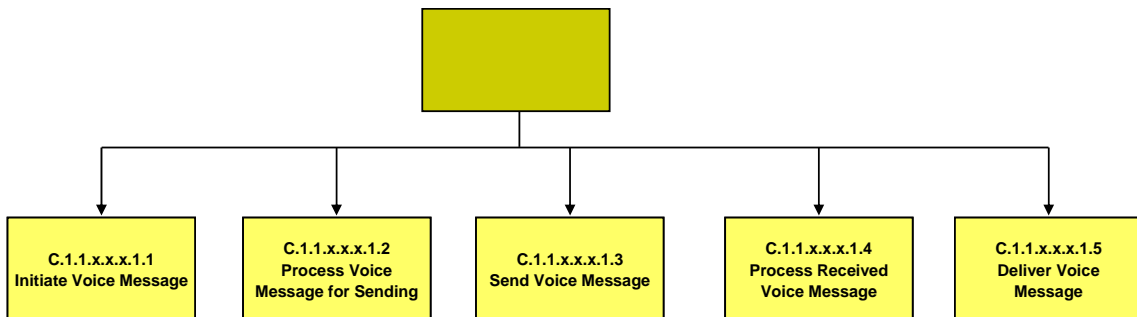
Figure A-13: Generic Decomposition of C.1.1.x.x.x.1: Voice Message
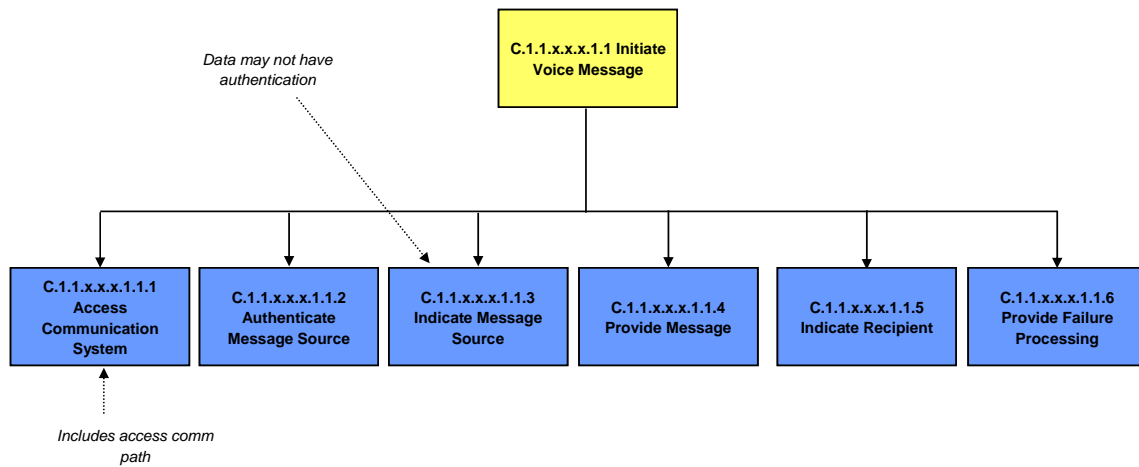
Figure A-14: Generic Decomposition of C.1.1.x.x.x.1.1: Initiate Voice Message
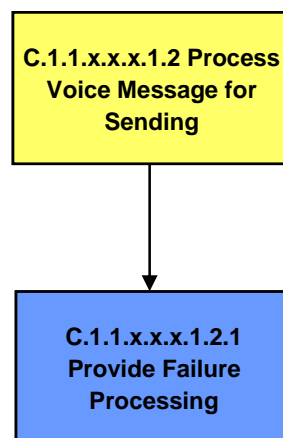
Figure A-15: Generic Decomposition of C.1.1.x.x.x.1.2: Process Voice Message for Sending
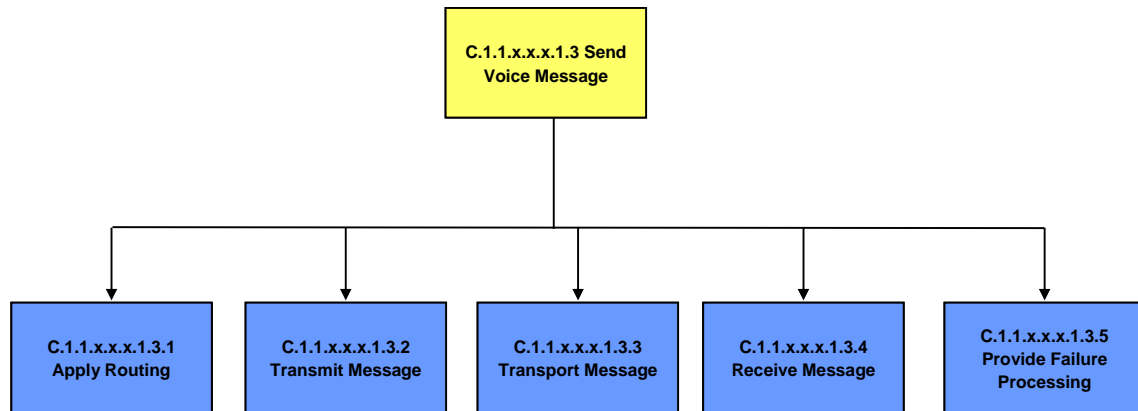
Figure A-16: Generic Decomposition of C.1.1.x.x.x.1.3: Send Voice Message
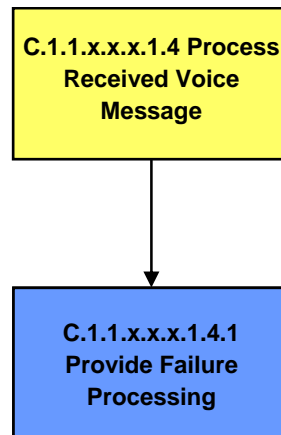
Figure A-17: Generic Decomposition of C.1.1.x.x.x.1.4: Process Received Voice Message
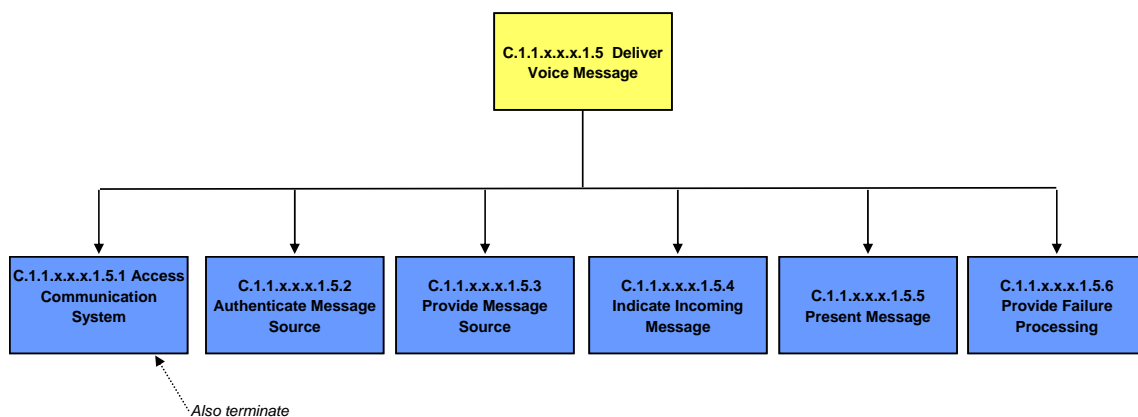
Figure A-18: Generic Decomposition of C.1.1.x.x.x.1.5: Deliver Voice Message
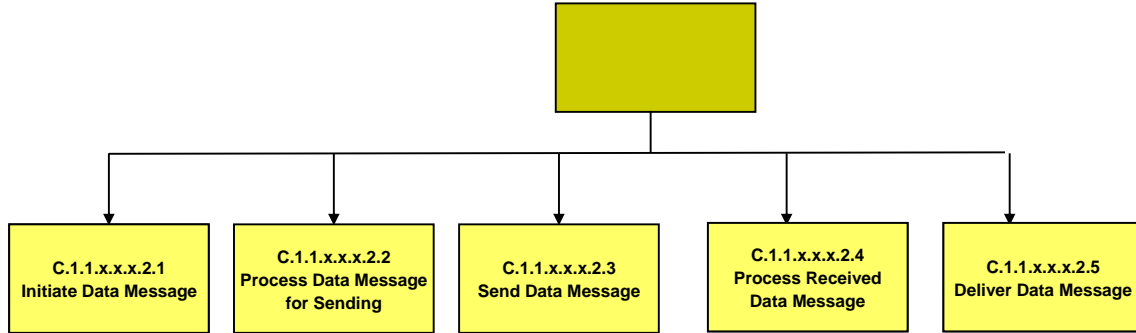
Figure A-19: Generic Decomposition of C.1.1.x.x.x.2: Data Message
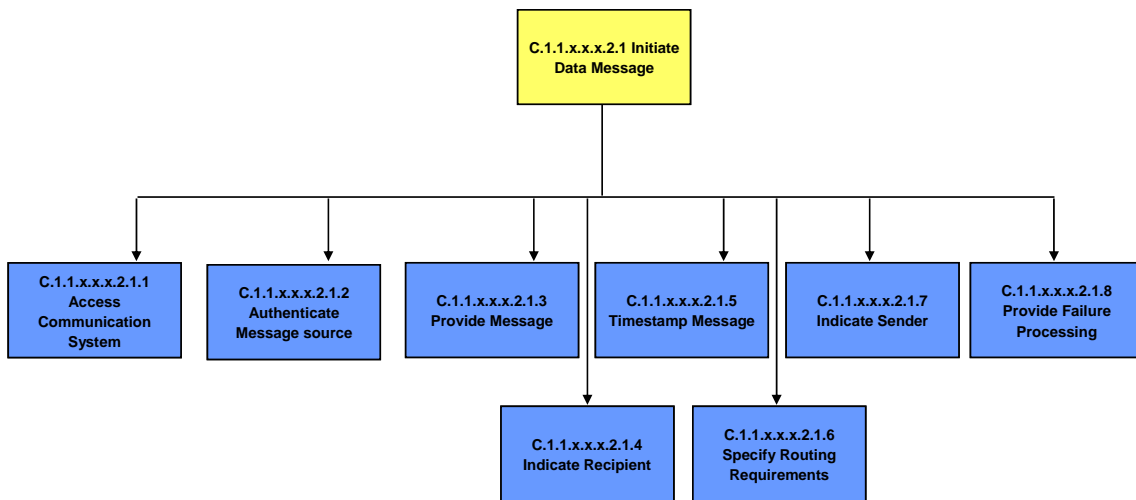
Figure A-20: Generic Decomposition of C.1.1.x.x.x.2.1: Initiate Data Message
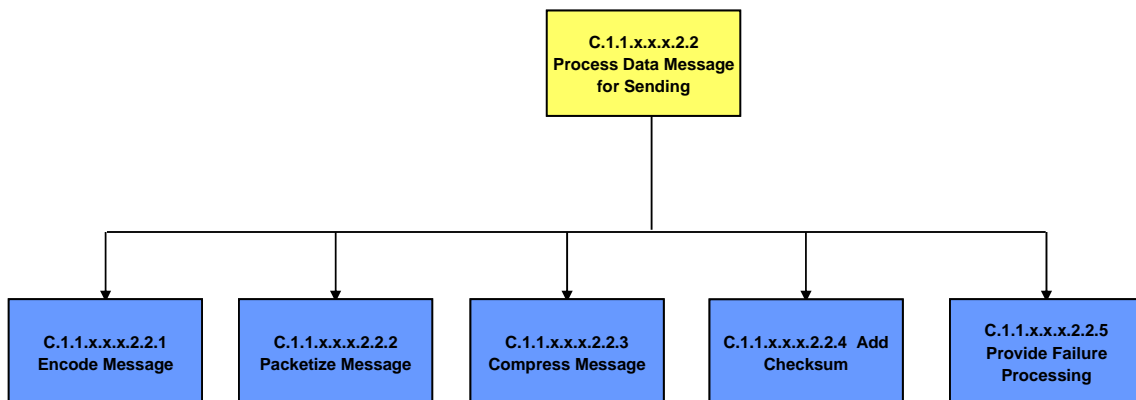
Figure A-21: Generic Decomposition of C.1.1.x.x.x.2.2: Process Data Message for Sending

C.1.1.x.x.x.2.3
Send Data Message

C.1.1.x.x.x2.3.1 Apply Routing	C.1.1.x.x.x2.3.2 Transmit Message	C.1.1.x.x.x2.3.3 Transport Message	C.1.1.x.x.x2.3.4 Receive Message	C.1.1.x.x.x2.3.5 Provide Failure Processing
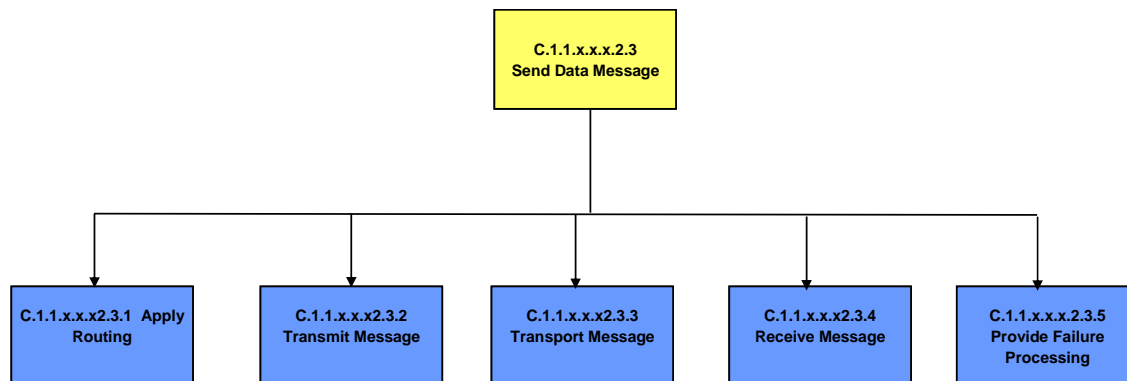
Figure A-22:   Generic Decomposition of C.1.1.x.x.x.2.3: Send Data Message

C.1.1.x.x.x.2.4 Process Received Data Message

C.1.1.x.x.x.2.4.1 Timestamp Message	C.1.1.x.x.x.2.4.2 Decode Message	C.1.1.x.x.x.2.4.3 Reconstitute Packetized Message	C.1.1.x.x.x.2.4.4 Decompress Message	C.1.1.x.x.x.2.4.5 Confirm Checksum	C.1.1.x.x.x.2.4.6 Provide Failure Processing
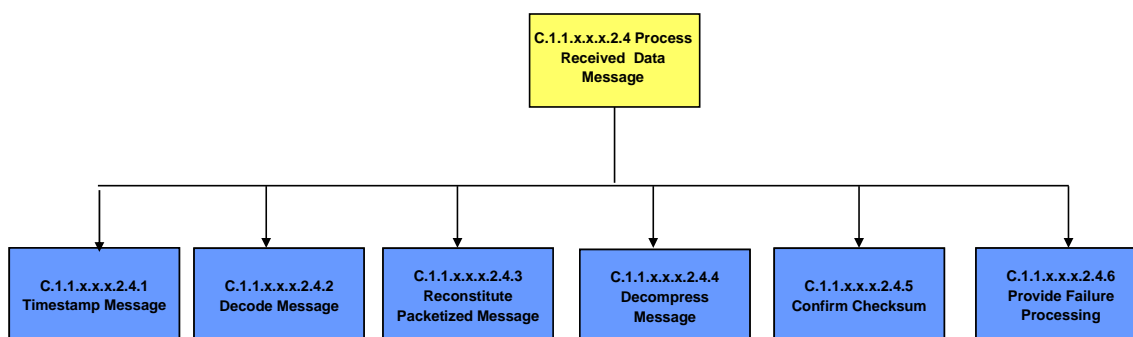
Figure A-23: Generic Decomposition of C.1.1.x.x.x.2.4: Process Received Data Message

C.1.1.x.x.x.2.5 Deliver Data Message

C.1.1.x.x.x.1.5.1 Access Communication System	C.1.1.x.x.x.1.5.2 Authenticate Message Source	C.1.1.x.x.x.1.5.3 Provide Message Source	C.1.1.x.x.x.1.5.4 Indicate Incoming Message	C.1.1.x.x.x.1.5.5 Present Message	C.1.1.x.x.x.1.5.6 Provide Failure Processing

Also terminate
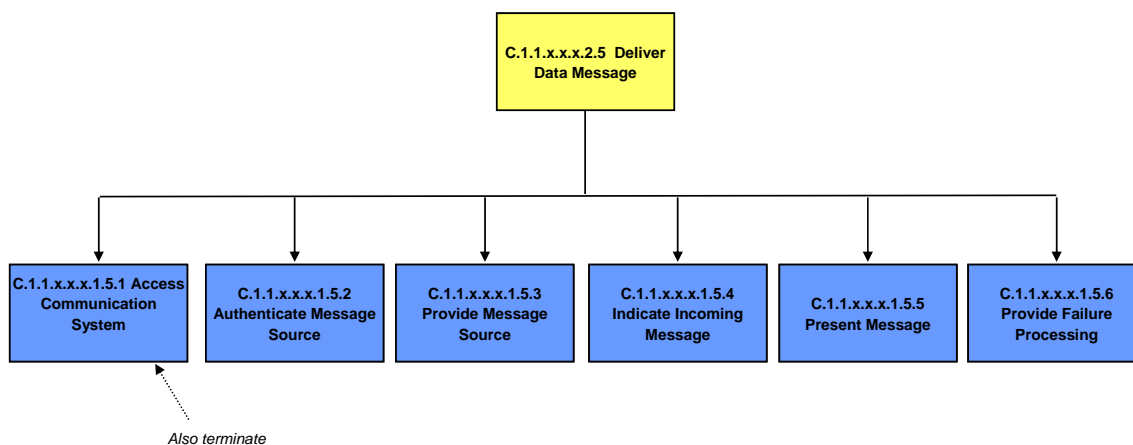
Figure A-24: Generic Decomposition of C.1.1.x.x.x.2.5: Deliver Data Message
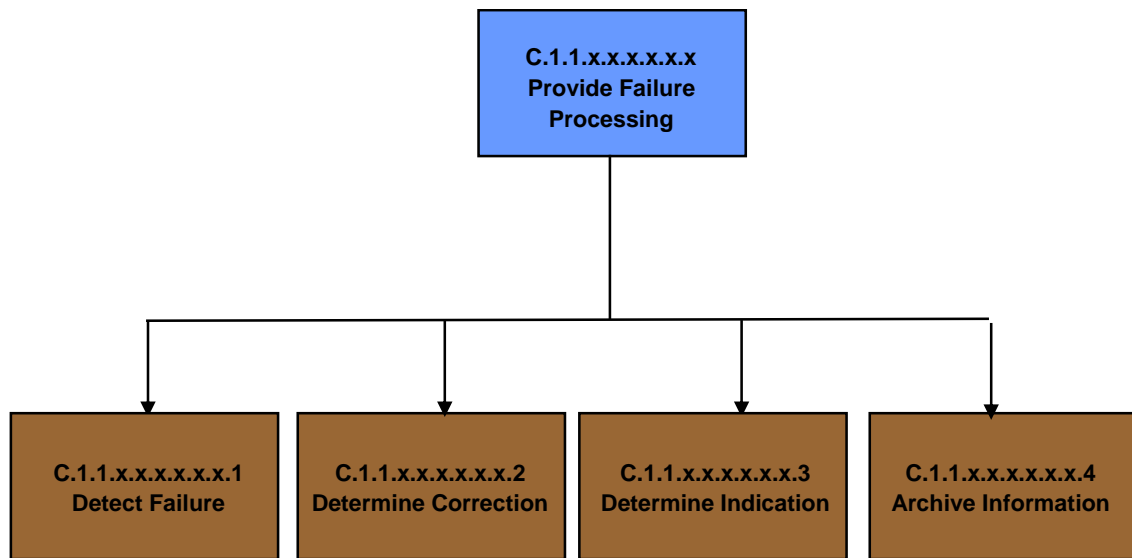
Figure A-25: Generic Decomposition of C.1.1.x.x.x.x.x.x: Provide Failure Processing

- **Authentication Failures**
- **Function Unavailability**
- **Message Unintelligible/Garbled**
- **Message Inaudible**
- **Message or Message Components Missing/Faulty**
- **Invalid/Incorrect message Components**
- **Checksum Failures**
- **Invalid Recipient**

Figure A-26: List of Failure Detection Sub-Functions
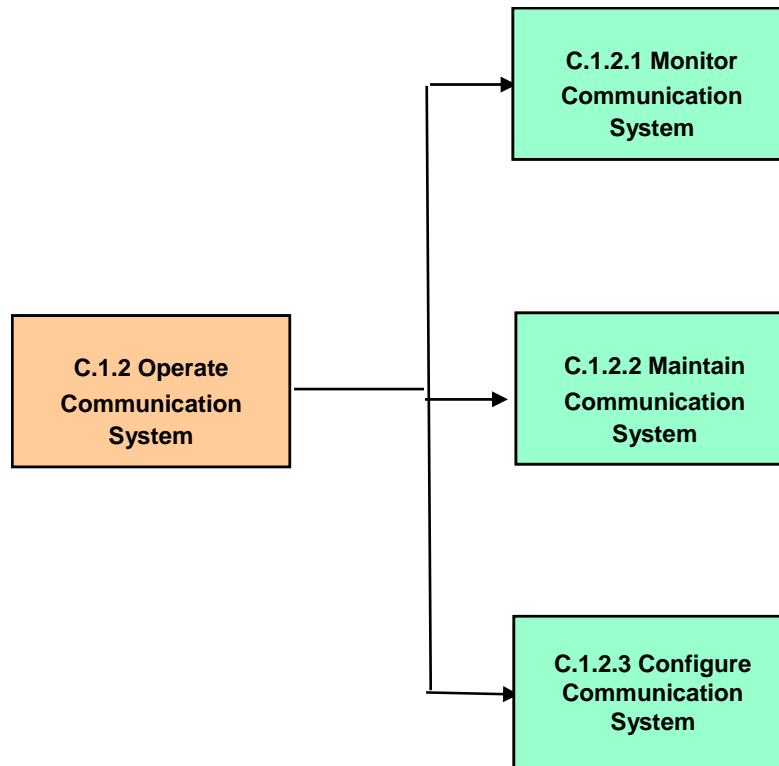
Figure A-27: Decomposition of C.1.2 Operate Communication System
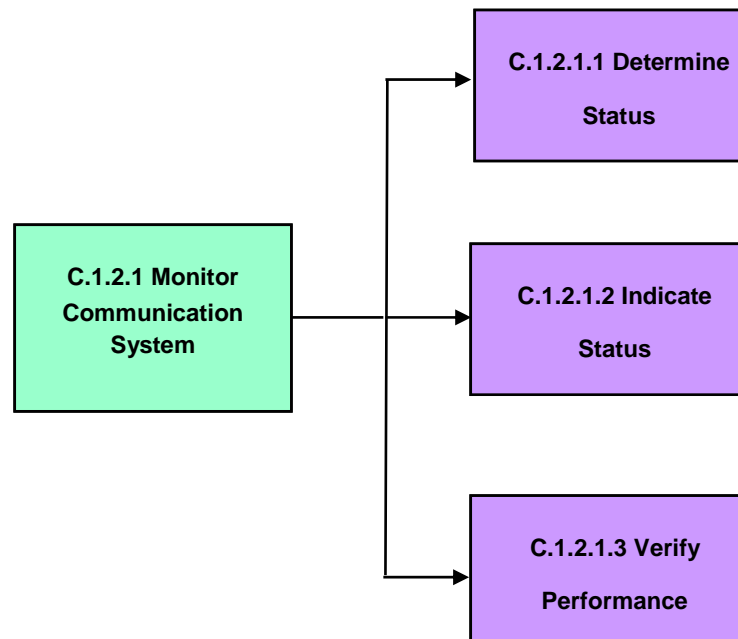
Figure A-28: Decomposition of C.1.2.1: Monitor Communication System
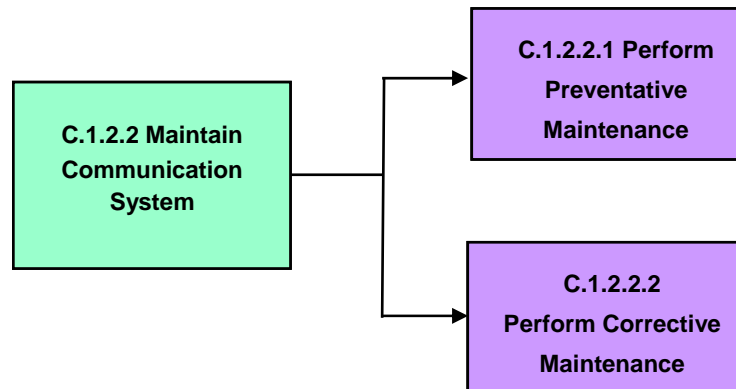
Figure A-29: Decomposition of C.1.2.2: Maintain Communication System
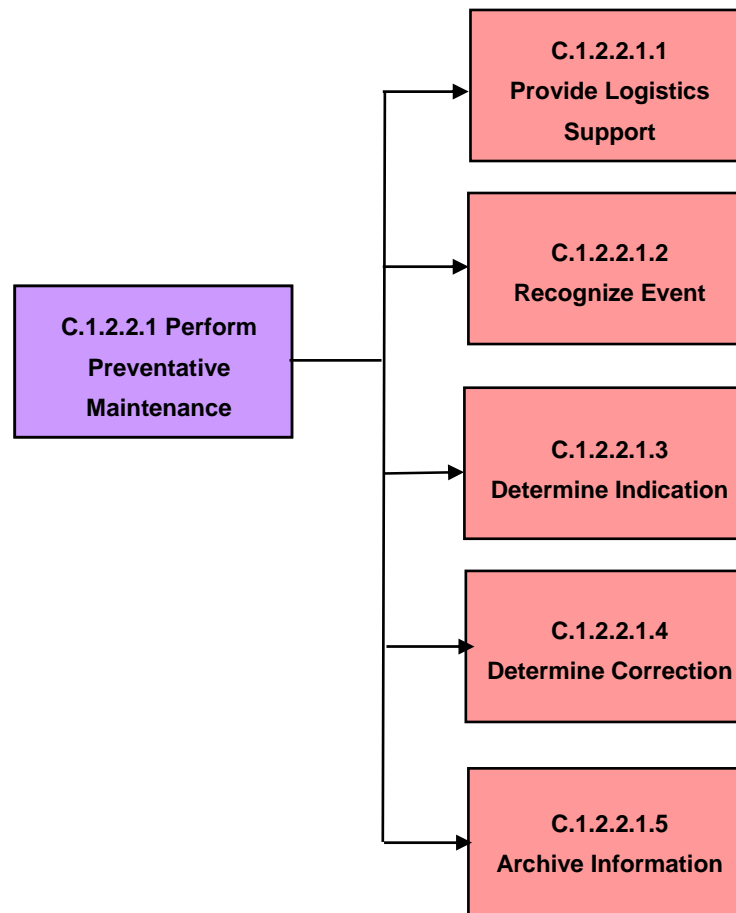
Figure A-30: Decomposition of C.1.2.2.1: Perform Preventative Maintenance
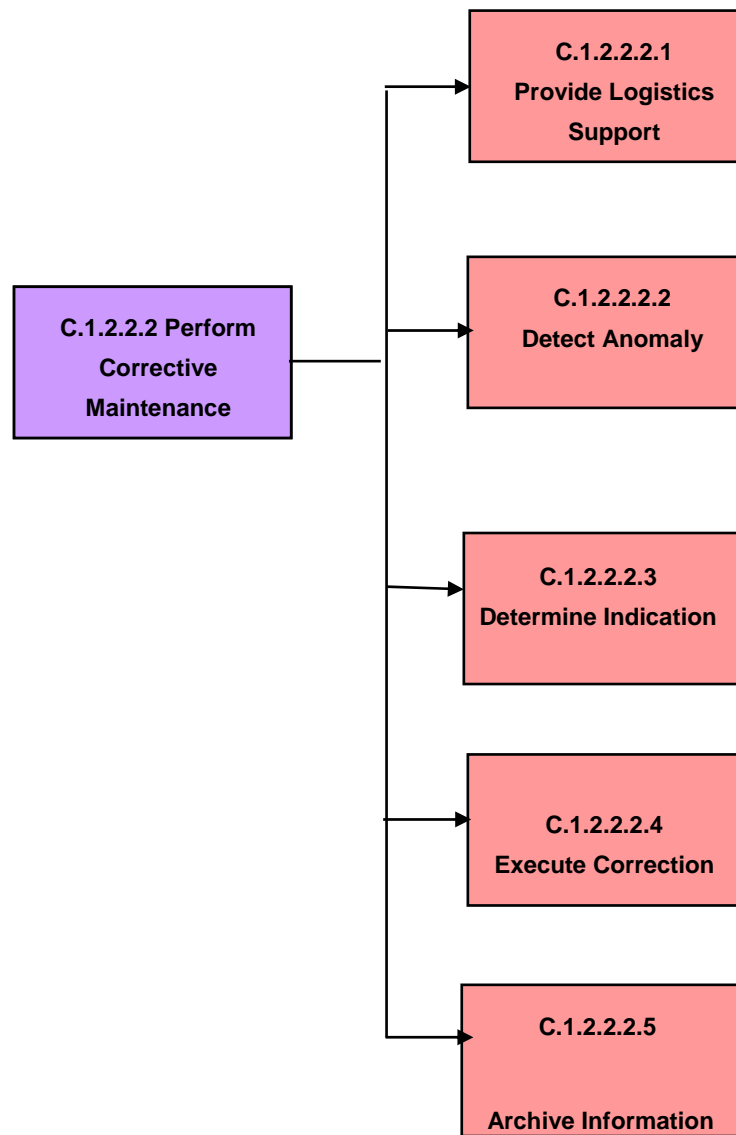
Figure A-31: Functional Decomposition of C.1.2.2.2: Perform Corrective Maintenance

C.1.2.3
Configure
Communication
System

C.1.2.3.1
Determine Capacity

C.1.2.3.2
Configure
Communication Path

C.1.2.3.3
Configure Security

C.1.2.3.4
Configure Parameters

These are the
parameters that are not
done in communication
path or security
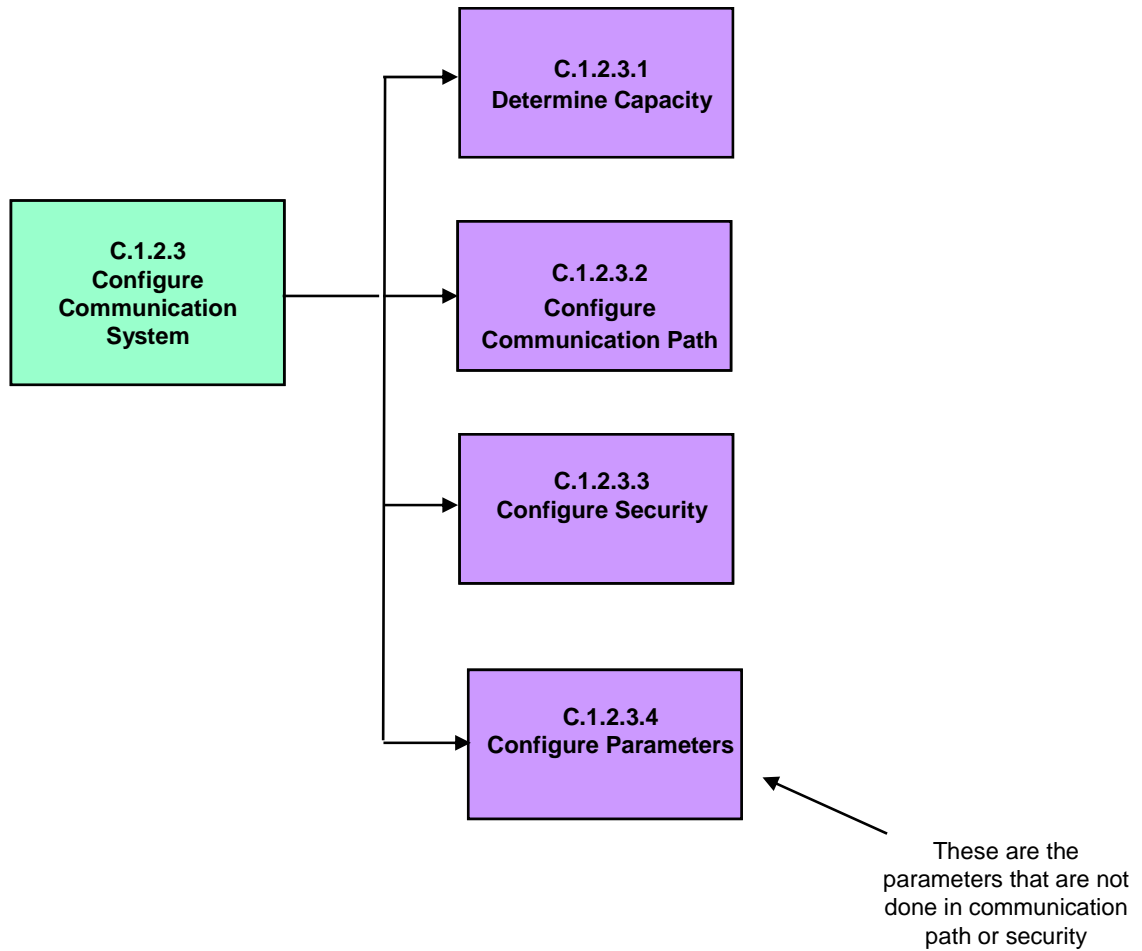
Figure A-32: Functional Decomposition of C.1.2.3: Configure Communication System
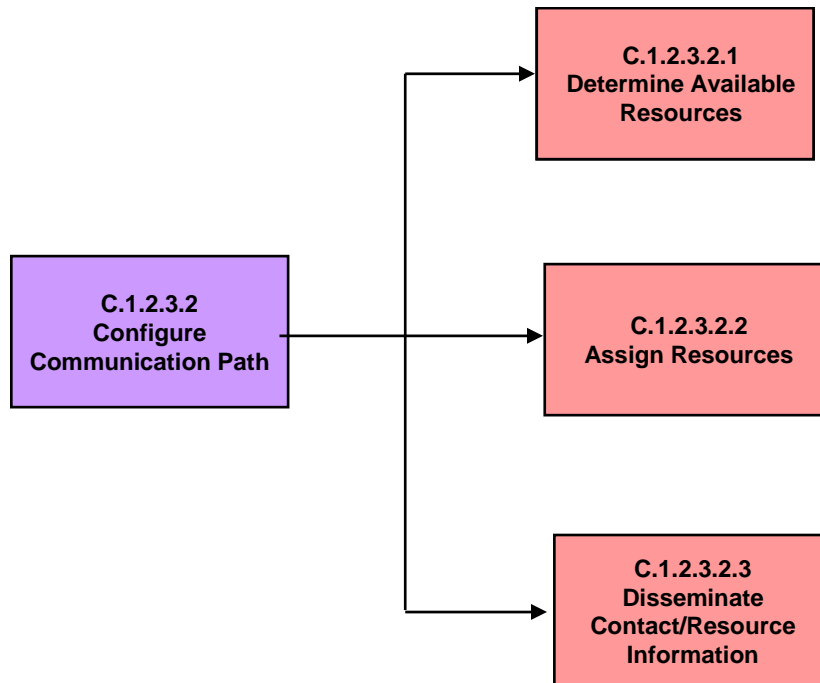
Figure A-33: Functional Decomposition of C.1.2.3.2: Configure Communication Path
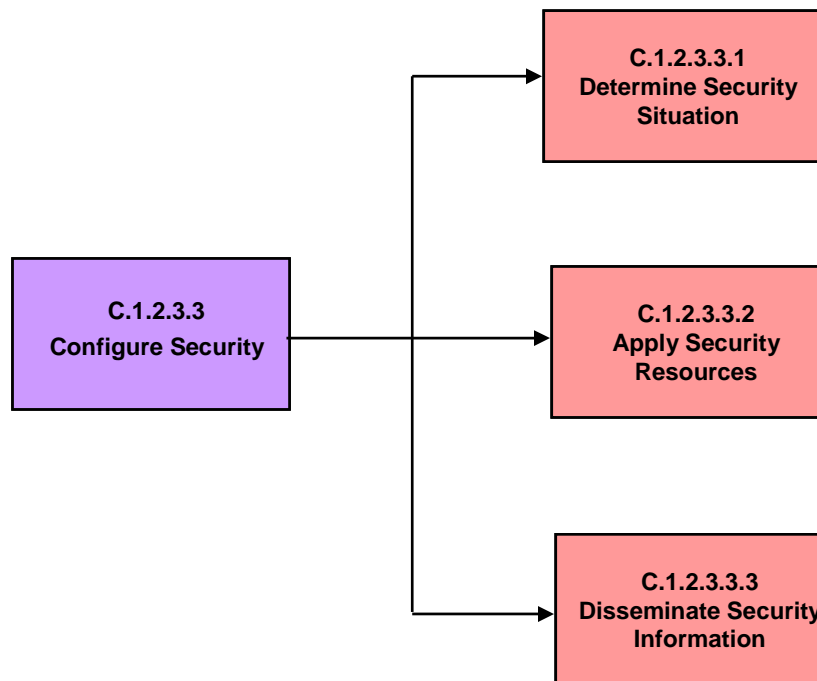
Figure A-34: Functional Decomposition of C.1.2.3.3: Configure Security

B   Appendix B: Full Functional Hierarchy (Outline Depiction)

Appendix B presents the same material as in Appendix A, but presents it in a hierarchical outline style. Since many of the low level functions are common to many functions, they are shown in **Insert A** and **Insert B** below, and then included for the first voice function (C.1.1.1.1.1.1 Transceive ATS to Airborne Aircraft Voice Message) and the first data function (C.1.1.1.1.1.1 Transceive ATS to Airborne Aircraft Voice Message) and just referenced thereafter. The functional analysis was used to structure both the safety and security analyses. The "C" preceding all of the numerical functional levels is used to represent "communication" – shorthand for the NAS Communication System.

Insert A: Generic Voice Message Functions

C.**1.1.x.x.x**.1.1 Initiate Voice Message
    C.**1.1.x.x.x**.1.1.1 Access Communication System
    C.**1.1.x.x.x**.1.1.2 Authenticate Message Source
    C.**1.1.x.x.x**.1.1.3 Indicate Message Source
    C.**1.1.x.x.x**.1.1.4 Provide Message
    C.**1.1.x.x.x**.1.1.5 Indicate Recipient
    C.**1.1.x.x.x**.1.1.6 Provide Failure Processing
        C.1.1.x.x.1.1.6.1 Detect Failure
        C.1.1.x.x.1.1.6.2 Determine Correction
        C.1.1.x.x.1.1.6.3 Determine Indication
        C.1.1.x.x.1.1.6.4 Archive Information
C.**1.1.x.x.x**.1.2 Process Voice Message for Sending
    C.**1.1.x.x.x**.1.2.1 Provide Failure Processing
        C.**1.1.x.x.x**.1.2.1.1 Detect Failure
        C.**1.1.x.x.x**.1.2.1.2 Determine Correction
        C.**1.1.x.x.x**.1.2.1.3 Determine Indication
        C.**1.1.x.x.x**.1.2.1.4 Archive Information
C.**1.1.x.x.x**.1.3 Send Voice Message
    C.**1.1.x.x.x**.1.3.1 Apply Routing
    C.**1.1.x.x.x**.1.3.2 Transmit Message
    C.**1.1.x.x.x**.1.3.3 Transport Message
    C.**1.1.x.x.x**.1.3.4 Receive Message
    C.**1.1.x.x.x**.1.3.5 Provide Failure Processing
        C.**1.1.x.x.x**.1.3.5.1 Detect Failure
        C.**1.1.x.x.x**.1.3.5.2 Determine Correction
        C.**1.1.x.x.x**.1.3.5.3 Determine Indication
        C.**1.1.x.x.x**.1.3.5.4 Archive Information
C.**1.1.x.x.x**.1.4 Process Received Voice Message
    C.**1.1.x.x.x**.1.4.1 Provide Failure Processing
        C.**1.1.x.x.x**.1.4.1.1 Detect Failure
        C.**1.1.x.x.x**.1.4.1.2 Determine Correction
        C.**1.1.x.x.x**.1.4.1.3 Determine Indication
        C.**1.1.x.x.x**.1.4.1.4 Archive Information
C.**1.1.x.x.x**.1.5 Deliver Voice Message
    C.**1.1.x.x.x**.1.5.1 Access Communication System
    C.**1.1.x.x.x**.1.5.2 Authenticate Message Source
    C.**1.1.x.x.x**.1.5.3 Provide Message Source
    C.**1.1.x.x.x**.1.5.4 Indicate Incoming Message
    C.**1.1.x.x.x**.1.5.5 Present Message
    C.**1.1.x.x.x**.1.5.6 Provide Failure Processing
        C.**1.1.x.x.x**.1.5.6.1 Detect Failure
        C.**1.1.x.x.x**.1.5.6.2 Determine Correction

C.**1.1.x.x.x**.1.5.6.3 Determine Indication
C.**1.1.x.x.x**.1.5.6.4 Archive Information

Insert B: Generic Data Message Functions

C.**1.1.x.x.x**.2.1 Initiate Data Message
    C.**1.1.x.x.x**.2.1.1 Access Communication System
    C.**1.1.x.x.x**.2.1.2 Authenticate Message source
    C.**1.1.x.x.x**.2.1.3 Provide Message
    C.**1.1.x.x.x**.2.1.4 Indicate Recipient
    C.**1.1.x.x.x**.2.1.5 Timestamp Message
    C.**1.1.x.x.x**.2.1.6 Specify Routing Requirements
    C.**1.1.x.x.x**.2.1.7 Indicate Sender
    C.**1.1.x.x.x**.2.1.8 Provide Failure Processing
        C.**1.1.x.x.x**.2.1.8.1 Detect Failure
        C.**1.1.x.x.x**.2.1.8.2 Determine Correction
        C.**1.1.x.x.x**.2.1.8.3 Determine Indication
        C.**1.1.x.x.x**.2.1.8.4 Archive Information
C.**1.1.x.x.x**.2.2 Process Data Message for Sending
    C.**1.1.x.x.x**.2.2.1 Encode Message
    C.**1.1.x.x.x**.2.2.2 Packetize Message
    C.**1.1.x.x.x**.2.2.3 Compress Message
    C.**1.1.x.x.x**.2.2.4 Add Checksum
    C.**1.1.x.x.x**.2.2.5 Provide Failure Processing
        C.**1.1.x.x.x**.2.2.5.1 Detect Failure
        C.**1.1.x.x.x**.2.2.5.2 Determine Correction
        C.**1.1.x.x.x**.2.2.5.3 Determine Indication
        C.**1.1.x.x.x**.2.2.5.4 Archive Information
C.**1.1.x.x.x**.2.3 Send Data Message
    C.**1.1.x.x.x**.2.3.1 Apply Routing
    C.**1.1.x.x.x**.2.3.2 Transmit Message
    C.**1.1.x.x.x**.2.3.3 Transport Message
    C.**1.1.x.x.x**.2.3.4 Receive Message
    C.**1.1.x.x.x**.2.3.5 Provide Failure Processing
        C.**1.1.x.x.x**.2.3.5.1 Detect Failure
        C.**1.1.x.x.x**.2.3.5.2 Determine Correction
        C.**1.1.x.x.x**.2.3.5.3 Determine Indication
        C.**1.1.x.x.x**.2.3.5.4 Archive Information
C.**1.1.x.x.x**.x.2.4 Process Received Data Message
    C.**1.1.x.x.x**.2.4.1 Timestamp Message
    C.**1.1.x.x.x**.2.4.2 Decode Message
    C.**1.1.x.x.x**.2.4.3 Reconstitute Packetized Message
    C.**1.1.x.x.x**.2.4.4 Decompress Message
    C.**1.1.x.x.x**.2.4.5 Confirm Checksum
    C.**1.1.x.x.x**.2.4.6 Provide Failure Processing
        C.**1.1.x.x.x**.2.4.6.1 Detect Failure
        C.**1.1.x.x.x**.2.4.6.2 Determine Correction
        C.**1.1.x.x.x**.2.4.6.3 Determine Indication
        C.**1.1.x.x.x**.2.4.6.4 Archive Information
C.**1.1.x.x.x**.2.5 Deliver Data Message
    C.**1.1.x.x.x**.2.5.1 Access Communication System
    C.**1.1.x.x.x**.2.5.2 Authenticate Message Source
    C.**1.1.x.x.x**.2.5.3 Provide Message Source
    C.**1.1.x.x.x**.2.5.4 Indicate Incoming Message
    C.**1.1.x.x.x**.2.5.5 Present Message
    C.**1.1.x.x.x**.2.5.6 Provide Failure Processing

C.**1.1.x.x.x**.2.5.6.1 Detect Failure
C.**1.1.x.x.x**.2.5.6.2 Determine Correction
C.**1.1.x.x.x**.2.5.6.3 Determine Indication
C.**1.1.x.x.x**.2.5.6.4 Archive Information

NAS Communication System Hierarchical Function Listing

C.1 Provide NAS ATC Communications
C.1.1 Use Communication System (Transceive Message)
C.1.1.1 Transceive Fixed to Mobile Message
C.1.1.1.1 Transceive Fixed to Airborne Mobile Message
C.1.1.1.1.1 Transceive ATS to Airborne Aircraft Message
C.1.1.1.1.1.1 Transceive ATS to Airborne Aircraft Voice Message
C.1.1.1.1.1.1.1 Initiate Voice Message
C.1.1.1.1.1.1.1.1 Access Communication System
C.1.1.1.1.1.1.1.2 Authenticate Message Source
C.1.1.1.1.1.1.1.3 Indicate Message Source
C.1.1.1.1.1.1.1.4 Provide Message
C.1.1.1.1.1.1.1.5 Indicate Recipient
C.1.1.1.1.1.1.1.6 Provide Failure Processing
C.1.1.1.1.1.1.1.6.1 Detect Failure
C.1.1.1.1.1.1.1.6.2 Determine Correction
C.1.1.1.1.1.1.1.6.3 Determine Indication
C.1.1.1.1.1.1.1.6.4 Archive Information
C.1.1.1.1.1.1.2 Process Voice Message for Sending
C.1.1.1.1.1.1.2.1 Provide Failure Processing
C.1.1.1.1.1.1.2.1.1 Detect Failure
C.1.1.1.1.1.1.2.1.2 Determine Correction
C.1.1.1.1.1.1.2.1.3 Determine Indication
C.1.1.1.1.1.1.2.1.4 Archive Information
C.1.1.1.1.1.1.3 Send Voice Message
C.1.1.1.1.1.1.3.1 Apply Routing
C.1.1.1.1.1.1.3.2 Transmit Message
C.1.1.1.1.1.1.3.3 Transport Message
C.1.1.1.1.1.1.3.4 Receive Message
C.1.1.1.1.1.1.3.5 Provide Failure Processing
C.1.1.1.1.1.1.3.5.1 Detect Failure
C.1.1.1.1.1.1.3.5.2 Determine Correction
C.1.1.1.1.1.1.3.5.3 Determine Indication
C.1.1.1.1.1.1.3.5.4 Archive Information
C.1.1.1.1.1.1.4 Process Received Voice Message
C.1.1.1.1.1.1.4.1 Provide Failure Processing
C.1.1.1.1.1.1.4.1.1 Detect Failure
C.1.1.1.1.1.1.4.1.2 Determine Correction
C.1.1.1.1.1.1.4.1.3 Determine Indication
C.1.1.1.1.1.1.4.1.4 Archive Information
C.1.1.1.1.1.1.5 Deliver Voice Message
C.1.1.1.1.1.1.5.1 Access Communication System
C.1.1.1.1.1.1.5.2 Authenticate Message Source
C.1.1.1.1.1.1.5.3 Provide Message Source
C.1.1.1.1.1.1.5.4 Indicate Incoming Message
C.1.1.1.1.1.1.5.5 Present Message
C.1.1.1.1.1.1.5.6 Provide Failure Processing
C.1.1.1.1.1.1.5.6.1 Detect Failure
C.1.1.1.1.1.1.5.6.2 Determine Correction
C.1.1.1.1.1.1.5.6.3 Determine Indication

C.1.1.3.2.3.2 Transceive NAS ATS to Foreign ATS Data Message
Insert B
C.1.1.3.2.4 Transceive Foreign ATS to NAS ATS Message
C.1.1.3.2.4.1 Transceive Foreign ATS to NAS ATS Voice Message
Insert A
C.1.1.3.2.4.2 Transceive Foreign ATS to NAS ATS Data Message
C.1.1.3.2.5 Transceive NAS ATS to non-NAS/OGA ATS Message
C.1.1.3.2.5.1 Transceive NAS ATS to non-NAS/OGA ATS Voice Message
Insert A
C.1.1.3.2.5.2 Transceive NAS ATS to non-NAS/OGA ATS Data Message
Insert B
C.1.1.3.2.6 Transceive non-NAS/OAG ATS to NAS ATS Message
C.1.1.3.2.6.1 Transceive non-NAS/OGA NAS ATS ATS Voice Message
Insert A
C.1.1.3.2.6.2 Transceive non-NAS/OGA NAS ATS ATS Data Message
Insert B
C.1.1.4 Transceive Mobile-Mobile Message
C.1.1.4.1 Transceive Airborne Mobile to Airborne Mobile Message
C.1.1.4.1.1 Transceive Airborne Aircraft to Airborne Aircraft Message
C.1.1.4.1.1.1 Transceive Airborne Aircraft to Airborne Aircraft Voice Message
Insert A
C.1.1.4.1.1.2 Transceive Airborne Aircraft to Airborne Aircraft Data Message
Insert B
C.1.1.4.2 Transceive Airborne Mobile to On-ground Mobile Message
C.1.1.4.2.1 Transceive Airborne Aircraft to On-ground Aircraft Message
C.1.1.4.2.1.1 Transceive Airborne Aircraft to On-ground Aircraft Voice Message
Insert A
C.1.1.4.2.1.2 Transceive Airborne Aircraft to On-ground Aircraft Data Message
Insert B
C.1.1.4.2.2 Transceive Airborne Aircraft to Vehicles Message
C.1.1.4.2.2.1 Transceive Airborne Aircraft to Vehicles Voice Message
Insert A
C.1.1.4.2.2.2 Transceive Airborne Aircraft to Vehicles Data Message
Insert B
C.1.1.4.3 Transceive On-ground Mobile to Airborne Mobile Message
C.1.1.4.3.1 Transceive On-Ground Aircraft to Airborne Aircraft Message
C.1.1.4.3.1.1 Transceive On-Ground Aircraft to Airborne Aircraft Voice Message
Insert A
C.1.1.4.3.1.2 Transceive On-Ground Aircraft to Airborne Aircraft Data Message
Insert B
C.1.1.4.3.2 Transceive Vehicles to Airborne Aircraft Message
C.1.1.4.3.2.1 Transceive Vehicles to Airborne Aircraft Voice Message
Insert A
C.1.1.4.3.2.2 Transceive Vehicles to Airborne Aircraft Data Message
Insert B
C.1.1.4.4 Transceive On-ground Mobile to On-ground Mobile Message
C.1.1.4.4.1 Transceive On-ground Aircraft to On-ground Aircraft Message
C.1.1.4.4.1.1 Transceive On-ground Aircraft to On-ground Aircraft Voice Message
Insert A
C.1.1.4.4.1.2 Transceive On-ground Aircraft to On-ground Aircraft Data Message
Insert B
C.1.1.4.4.2 Transceive On-Ground Aircraft to Vehicle Message
C.1.1.4.4.2.1 Transceive On-Ground Aircraft to Vehicle Voice Message
Insert A
C.1.1.4.4.2.2 Transceive On-Ground Aircraft to Vehicle Data Message
Insert B

C.1.1.4.4.3 Transceive Vehicle to On-ground Aircraft Message
    C.1.1.4.4.3.1 Transceive Vehicle to On-ground Aircraft Voice Message
        Insert A
C.1.1.4.4.3.2 Transceive Vehicle to On-ground Aircraft Data Message
    Insert B
C.1.1.4.4.4 Transceive Vehicle to Vehicle Message
C.1.1.4.4.4.1 Transceive Vehicle to Vehicle Voice Message
    Insert A
C.1.1.4.4.4.2 Transceive Vehicle to Vehicle Data Message
    Insert B
C.1.2 Operate Communication System
  C.1.2.1 Monitor Communication System
    C.1.2.1.1 Determine Status
    C.1.2.1.2 Indicate Status
    C.1.2.1.3 Verify Performance
  C.1.2.2 Maintain Communication System
    C.1.2.2.1 Perform Preventative Maintenance
      C.1.2.2.1.1 Provide Logistics Support
      C.1.2.2.1.2 Recognize Event
      C.1.2.2.1.3 Determine Indication
      C.1.2.2.1.4 Determine Correction
      C.1.2.2.1.5 Archive Information
    C.1.2.2.2 Perform Corrective Maintenance
      C.1.2.2.2.1 Provide Logistics Support
      C.1.2.2.2.2 Detect Anomaly
      C.1.2.2.2.3 Determine Indication
      C.1.2.2.2.4 Archive Information
  C.1.2.3 Configure Communication System
    C.1.2.3.1 Determine Capacity
    C.1.2.3.2 Configure Communication Path
      C.1.2.3.2.1 Determine Available Resources
      C.1.2.3.2.2 Assign Resources
      C.1.2.3.2.3 Disseminate Contact/Resource Information
    C.1.2.3.3 Configure Security
      C.1.2.3.3.1 Determine Security Situation
      C.1.2.3.3.2 Apply Security Resources
      C.1.2.3.3.3 Disseminate Security Information

C   Appendix C: Physical Architecture

This appendix describes components of the physical architecture of the NAS communication system.   The information is from the agency's Currant Book, a document mandated by FAA Orders 1830.6b1 and 4441.16. The latest version of the Currant Book is for fiscal year 2003. The Currant Book and updated addendums are obtainable via the agency's intranet at:

http://tso.faa.gov/index.cfm?fuseaction=Documents.main&liteGroup=TSO#Fuchsia%20and%20Currant%20Books

Voice communications is the primary means of communications among ATC facilities and between an air traffic controller and a pilot. Voice switching provides the air traffic controller both ground-ground Interfacility/Intrafacility and air-ground voice communications connectivity. Legacy voice switches considered for this report are the following:

- Voice Switching and Control System (ATRCC only),
- Enhanced Terminal Voice Switch,
- Integrated Communications Switching System Type 1, Type 2, and Type 3,
- Rapid Deployment Voice Switch Type I, Type II and Type IIA, and
- Small Tower Voice Switch.

The components identified in Table C-1 were taken from the 2003 Currant Book. More detail about each component is available online at the aforementioned link.

The third column of Table C-1 indicates whether the communications component was considered applicable (inbounds) in the Safety Hazard Analysis and Security Threat Analysis effort.

The FAA Telecommunications Infrastructure (FTI) program is the primary means for the FAA to acquire telecommunications services through FY2017. The objective of the FTI Program is to leverage commercial services capable of meeting the present and future needs of programs requiring inter-facility telecommunications for the FAA.

The proposed telecommunications service environment will be designed to use modern, highly reliable, consolidated network infrastructure, effectively incorporating multi-service capabilities at the lowest possible cost. New and upgraded services will be added as communications technology and FAA needs evolve. Once transition is completed, FTI will provide approximately 30,000 telecommunications services to over 5,000 FAA and non-FAA facilities.

Table C-1: NAS Communication System Physical Architecture Components

Name	Purpose	Applicability

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[1] FAA Order 1830.6b is titled "Telecommunications Asset Management" dated December 18, 2000.

Name	Purpose	Applicability
Bandwidth Manager (BWM)	The purpose of the BWM is to provide advanced multi-service bandwidth management to the NAS telecommunications network. BWM consolidates network services onto an integrated backbone network of nodes, connected with FAA-owned or leased links.	Yes
Data Multiplexing Network (DMM)	Data multiplexing is a technique that enables consolidation of a number of low-speed, independent data transmission requirements into a single high-speed communication link, typically using a leased voice-grade private circuit or Radio Communications Link (RCL) channel. Using this technology, the DMN satisfies multiple data requirements with a minimum number of discrete circuits. This results in a more efficient use of bandwidth at lower cost. The interfacility configuration of DMM also provides redundant transmission paths, automatic switching where required, and integral monitoring of the multiplexing equipment and circuits.	Yes
Radio Communications Link (RCL)	RCL is an integrated voice and data microwave transmission system designed to provide the FAA with cost-effective and reliable service for its high capacity NAS communications routes.	Yes
Low Density Radio Communications Link (LDRCL)	LDRCL is an integrated voice and data digital microwave transmission system designed to provide the FAA with cost-effective and reliable service for short-haul NAS communications routes. It can be deployed either as a point-to-point system, a backbone system with spurs, or as a means to gain access to the RCL at a Drop and Insert Point (DIP) site.	Yes
Television Microwave Link (TML)	TML transmits Bright Radar Indicator Tower Equipment (BRITE) or Digital Bright Radar Indicator Tower Equipment (DBRITE) radar display information from an Automated Radar Terminal System (ARTS) facility to satellite Air Traffic Control Towers (ATCTs).	No
Radar Microwave Link (RML)	RML was the precursor to Radio Communications Link (RCL). It is an analog microwave transmission system designed to connect Air Route Surveillance Radar (ARSR) sites with Air Route Traffic Control Centers (ARTCCs). Most RML sites were converted to RCL sites. However, there are some RML point-to-point systems existing in the NAS, but they are at their lifecycle end and are being studied for replacement.	Yes
Lease Interfacility NAS Communications System (LINCS)	LINCS provides operational telecommunication connectivity for critical aviation services. LINCS provides various industry-standard transmission channel types between any specified end points. LINCS channels provide - to all FAA operational telecommunications - dedicated circuits that are for non-routine use.	Yes
National Airspace Data Interchange Network (NADIN) Message Processing Service (NADIN I) (NADIN Message Switched Network (MSN))	NADIN I is a store-and-forward message-switched data network. It replaced and combined the United States (U.S.)-operated portion of the Aeronautical Fixed Telecommunication Network (AFTN) in conformance with International Civil Aviation Organization (ICAO) requirements and the now-decommissioned Automated Data Interchange System Service B (ABDIS).	Yes
National Airspace Data Interchange Network (NADIN II)	NADIN II is part of the data-switching sub-element of the NAS communications element. It currently provides high-speed data communications between other sub-systems in the NAS.	Yes
Alaskan NAS Interfacility Communications System (ANICS)	ANICS is an integrated voice and data transmission system of 51 dual-diversity sites providing interfacility communications in the Alaskan Region. There is also an ANICS facility located at the Seattle ARTCC.	Yes
FAA Telecommunications Satellite (FAATSAT)	FAATSAT is a leased service that consolidates existing satellite services, as well as future requirements, into a single program. Satellite service is currently provided in the Contiguous United States (CONU.S.) for a significant number of en route radar data circuits and air-ground voice circuits. FAATSAT also provides broadcast service in support of the FAA Bulk Weather Telecommunications Gateway system.	Yes
Defense Messaging System (DMS)	DMS is the principal long-haul record communications network within the Defense Information System Network providing secure data transmission. The purpose of the DMS is to handle command and control, operations, intelligence, logistic, diplomatic, and administrative data traffic. This service is at FAA Headquarters, Radar Operations Centers, National Emergency Operations Facility, ARTCCs, Center Radar Approach Centers (CERAPs), Air Traffic Control System Command Center (ATCSCC), FAA Aeronautical Center or Academy (ARCTR), FAA Technical Center, and the alternate headquarters command and control facility.	Yes

Name	Purpose	Applicability
Administrative Data (ADDA)	ADDA service provides administrative data capability to support FAA switched data and Wide Area Network (WAN) requirements. The majority of ADDA services use the Public Switched Telecommunications Network (PSTN); relatively few use WAN services.	No
Administrative Equipment Systems (ADSY)	ADSY provides voice communications, switching and call handling equipment for administrative support at FAA facilities.	No
Administrative Voice (ADVO)	ADVO service provides the administrative voice capability (exchange service) to support the NAS. ADVO services are administered by regional Airway Facilities Operations Branch personnel.	No
Federal Telecommunications Service (FTS)	FTS provides government users with voice, data, and video services provided by multiple carriers under multiple contracts managed by the General Services Administration (GSA). MCI is the FTS2001 vendor providing administrative (and limited NAS) leased telecommunications services to the FAA. The FTS2001 contract includes domestic and international voice and data services such as Virtual Network service, calling card, prepaid cards, toll free service, audio conferencing, video conferencing, private line, frame relay, ATM, Internet and paging services.	No
Federal Telecommunications Infrastructure (FTI)	FTI is the primary means for the FAA to acquire telecommunications services through FY2017.	Yes with exceptions (no navigation or surveillance)
Emergency Command & Control Communications System (CCCC)	CCCC's primary objective is to provide minimum essential command and control communications capability during a national, regional or local emergency. The CCCC supports the direction, management, operation, and reconstitution of the NAS by FAA/ Department of Transportation (DOT)/DoD when normal Telco common carrier services are interrupted. The non-emergency, day-to-day mission provides command and control communications support during normal FAA operations. Such communications may support maintenance, flight-check aircraft, crash site investigation teams, civil aviation security, and other agencies.	No (only as a backup to primary communications)
Emergency Voice Communications System (EVCS)	EVCS meets National Security and Emergency Preparedness responsibilities mandated by Presidential Order and interagency agreements. EVCS supports FAA Headquarters, ATCSCC, and Regional Communications Control Centers (RCCCs) functions for accident and incident reports, hijackings, airline crashes, aviation security matters, military activities, natural disasters, etc.	No (only as a backup to primary communications)
Miscellaneous & Accounting Records (ACCT): Accounting (MISC)	MISC service consists of telecommunications requirements that cannot be categorized by any other service name or are temporarily assigned until a more appropriate category can be determined or established.	No
NAS Recovery Communications: FAA Command and Control Communications (RCOM/C3)	RCOM/C3 is mandated by a variety of national level documents, including Executive Orders and National Security Decision Directives. The RCOM/C3 program was established to encompass all FAA emergency command and control systems, and to consolidate the various FAA emergency command and control development projects under one program. Emergency and control communications systems are defined as those means of communications FAA employs to direct management, operations, and reconstitution of the NAS in support of FAA, DOT, and DoD missions during national disasters or national security emergencies when normal common carrier telephone circuits become disrupted.	No (only as a backup to primary communications)
Emergency Command and Control Communications (C3)	C3 systems are defined as those means of communications that the FAA employs to direct management, operations, and reconstitution of the NAS in support of FAA, DOT, and DOD missions during national disasters or national security emergencies. The FAA maintains a variety of fixed-position, portable, and transportable C3 communications systems for use in support of emergency operations. Such C3 system includes: National Radio Communications System (NARACS), High Frequency/Single Side Band (HF/SSB), Defense Messaging System (DMS), Very High Frequency/Frequency Modulated (VHF/FM), Secure Telephone Equipment (STE), Secure Facsimile, satellite telephone network (AMSC), Automated Notification System (ANS), Secure Conferencing System (SCS), and the Communications Support Teams (CST). *Note: Command and Control Communications (C3), was previously called Recovery Communications (RCOM).*	No (only as a backup to primary communications)

Name	Purpose	Applicability
Interphone Service F (D) (SVF)	Interphone Service F is a comprehensive, nationwide system of leased voice networks which interconnect FAA, military, National Weather Service (NWS), Coast Guard, and some non-government aviation facilities for the control and management of aircraft flights. Service F network's primary purpose is the expeditious transfer of flight information between positions and facilities responsible for the safety of aircraft in flight. The network is employed by controllers for communicating radar hand-offs between FAA facilities and foreign country facilities that have abutting airspace.	Yes
Aeronautical Fixed Services (AFS)	AFS provides voice and data communications between U.S.-controlled Flight Information Regions (FIRs) and those adjacent FIRs controlled by other countries. Data services to other ICAO regions are also required to support data on inter-regional and long haul flights. The voice and data communications program is designed to support the U.S./FAA commitments to international aviation. There is an international requirement for direct voice and data communications between adjacent international FIRs. International flight information centers and area control facilities need to communicate with their adjacent counterparts to exchange real-time air traffic control messages. Regional air navigation agreements may specify message form and retention requirements. Facilities for communications between control centers serving contiguous control areas include direct-voice communications to establish instantaneous radar control transfer and for other purposes.	Yes
Aeronautical Fixed Telecommunications Network (AFTN)	AFTN is a worldwide network that supports the data communications requirement of the international civil aviation community. Each country in the network has an active communications center that relays aeronautical information to and from the interconnecting AFTN centers. AFTN provides interchange of flight plans and control messages, weather data, distress messages, international Notice to Airmen (NOTAMs), and other operational messages.	Yes
Aeronautical Mobile communications Service (AMCS)	AMCS provides air-ground communications between controllers and pilots in the oceanic domain. Air-ground communications are classified as the Aeronautical Mobile (Route) Service (AM(R)S). ICAO en route High Frequency (HF) Radio Telephony Networks have been implemented for worldwide application of HF (AM(R)S) Major World Air Route Area operations in support of international civil aviation en route communications beyond the line-of-sight limitations of VHF. These networks handle the defined, acceptable categories of traffic, including air traffic control, meteorology, notices to airmen, and operational control. ARINC provides AMCS in U.S. responsible airspace, under contract with the FAA. Long-range HF radio facilities provide international oceanic voice communications service from ARINC aeronautical stations located at New York and San Francisco. VHF radio stations are installed at selected shoreline locations to provide VHF service as far as possible into the oceanic areas as a supplement to the HF coverage.	Yes
Mejoras al Enlace de Voz del ATS (MEVA)	MEVA is a program that provides modern voice and data circuit connectivity for FAA ATC communications between the U.S. and ICAO member countries of the Caribbean and Latin America Regions. Ground earth stations are operational in 13 member countries. MEVA provides a mix of point-to-point and demand-assigned multiple access voice and data circuits to support FAA communications.	Yes

Name	Purpose	Applicability
Aeronautical Telecommunications Network (ATN)	The Aeronautical Telecommunications Network (ATN) is an evolving global data Internet infrastructure developed by the ICAO. The ATN will be comprised of an interconnection of computers with gateways or routers via real sub-networks. This allows the construction of a homogeneous virtual data network in an environment of administrative and technical diversity. Given the desire to interconnect an evolving and ever wider variety of aircraft and ground-based computers to accomplish air traffic management, it is clear that the civil aviation community needs a global data Internet. The ATN design allows communications services for different user groups; i.e., ATS, Airline Operational Control (AOC), Aeronautical Administration Communication (AAC), and Aeronautical Passenger Communication (APC). The design provides for the incorporation of different air-ground sub-networks and different ground-ground sub-networks (e.g., AFS, AMCS), resulting in a common data transfer service. These two aspects are the basis for interoperability of the ATN and will provide a reliable data transfer service for all users. The design is such that user communications services can be introduced in an evolutionary manner. Trials of the ATN ground-based system with Japan began in 2000. Subsequent ground-based systems will be integrated with the CPDLC network. The ground-ground application, Automated Message Handling System (AMHS), is adopted by the ICAO member states to replace the existing AFTN that is currently being host by NADIN I.	No
World Area Forecast System (WAFS)	The FAA has agreed to provide funding to the NWS for the U.S.-responsible telecommunications support of World Area Forecast System (WAFS) operated on behalf of the Contracting States of the ICAO. The WAFS provides en route forecasts of upper winds, upper-air temperatures, tropopause, and significant weather in pictorial form (and for grid points in digital form), for use by aircraft operators, flight crew members, ATS units, and other aeronautical users. The U.S. responsibility includes distribution of forecast data generated by the Washington World Area Forecast Center (WAFC) to nations located in approximately two-thirds of the Earth's surface via satellite broadcast employing two space segments: one providing distribution to the Caribbean, North, Central, and South America, and the North and South Atlantic Oceans, and the other to the Pacific Basin, the Far East, Southeast Asia, Australia, and New Zealand. The U.K. has similar responsibilities for the world's other nations in Europe, Africa, and the Indian Ocean region.	No

D   Appendix D: Safety Hazard Analysis Worksheets

D.1   Overview

For the NAS Communication System, fifteen safety hazards categories were identified::

- hazards due to lack of availability of the NAS Communication System,
    1. NAS Communication Capability Totally Unavailable – NAS ATS failure,
    2. NAS Communication Capability Partially Unavailable – NAS ATS failure,
    3. NAS Communication Capability Unavailable –Non-NAS failure
- hazards due to failures of the NAS Communication System,
    4. NAS communication fails (e.g., aborts) with a given recipient for a single message
    5. NAS communication fails (e.g., aborts) with multiple recipients for a single message per aircraft
- hazards due to mis-delivery of a message by the NAS Communication System,
    6. The recipient accepts a message affecting separation from a NAS ATS that is not its control authority.
    7. The recipient accepts a message NOT affecting separation from a NAS ATS that is its control authority.
    8. A message affecting separation gets to unintended recipient.
    9. A message NOT affecting separation gets to unintended recipient
- hazards due to late delivery of a message by the NAS Communication System,
    10. Message affecting separation received too late (or expired)
    11. Message NOT affecting separation received too late (or expired)
- hazards due to corruption of message by the NAS Communication System, and
    12. A message affecting separation corrupted
    13. A message NOT affecting separation corrupted
- hazards due to messages arriving out-of-sequence due to the NAS Communication System.
    14. A message affecting separation sent/received out of sequence (undetected)
    15. A message NOT affecting separation sent/received out of sequence (undetected).

These fifteen hazard categories were then applied to each of the high level NAS Communication System functions as follows:

Transceive Fixed to Mobile Message

1. ATS to Airborne Aircraft Message

2. ATS to On-Ground Aircraft Message

3. ATS to Vehicles Message

Transceive Mobile to Fixed Message

4. Airborne Aircraft to ATS Message

5. On-Ground Aircraft to ATS to Message

6. Vehicles to ATS Message

Transceive Fixed to/from Fixed Message

7. Internal NAS ATS Intrafacility Message

8. Internal NAS ATS Interfacility Message

9. NAS ATS to Other Government Agency (OGA) Message

10. OGA to NAS ATS Message

11. NAS ATS to Foreign ATS Message

12. Foreign ATS to NAS ATS Message

13. NAS ATS to non-NAS/non-OGA Message

14. Non-NAS/non-OGA to NAS ATS Message

Transceive Mobile to Mobile Message

15. Airborne Aircraft to Airborne Aircraft Message

16. Airborne Aircraft to On-Ground Aircraft Message

17. On-Ground Aircraft to Airborne Aircraft Message

18. Airborne Aircraft to Vehicles Message

19. Vehicles to Airborne Aircraft Message

20. On-Ground Aircraft to On-Ground Aircraft Message

21. On-Ground Aircraft to Vehicle Message

22. Vehicle to On-Ground Aircraft Message

23. Vehicle to Vehicle Message

For each of these 23 NAS Communication System functions a typical list of the types of messages transmitted is shown in Table D-1. For some of the functions, no messages are currently exchanged, but the functionality was included for completeness. For some functions, the hazard scenarios were considered to be the same; and thus a single hazard worksheet table can be used for more than one function. The last column of Table D-1 provides a cross reference to the function's hazard worksheet table.

Note: MMC communications (function C.1.2, see Appendix A) are not explicitly used to define hazards because the impact of a failure of these functions would principally be causes of other hazards rather than specific MMC communication hazards.

Table D-1: NAS Communication SHA Table Cross Reference

	Information Type (incl corresponding function ID)	Message Examples	Hazard Table Cross Reference
1	C.1.1.1.1.1 Transceive ATS to Airborne Aircraft Message	• Clearances • Contact/Monitor Instructions • Check Stuck Microphone • Transfer Instructions • Automated Terminal Information Service (ATIS) • Significant Meteorological Information (SIGMETs) • Hazardous Inflight Weather Advisory (2-6-2 FAA Order 7110.65P) • NAS Status Advisories • ADS Contract/Reports • Wake Turbulence (2-1-19-20 FAA Order 7110.65P) • Traffic Advisories (2-1-21 FAA Order 7110.65P) • Bird Activity (2-1-22 FAA Order 7110.65P) • Pilot Report (PIREP) (2-6-3 FAA Order 7110.65P) • Arrival Runway Visual Range (RVR)/RVV (2-8-2 FAA Order 7110.65P) • Low Level Wind Shear/Microburst Advisories (3-1-8 FAA Order 7110.65P)	Table D-2
	C.1.1.2.1.1 Transceive Airborne Aircraft to ATS Message	• Requests • Clearance/Instruction Responses • Emergency/Urgency Declarations • Contact Messages (providing frequency) • Weather Reports • ATIS Requests • Reports • Position Reports • Intent Data • PIREP (2-6-3 FAA Order 7110.65P)	Table D-2
2	C.1.1.1.2.1 Transceive ATS to On-Ground Aircraft Message	• Clearances • Contact/Monitor Instructions • Check Stuck Microphone • Transfer Instructions • ATIS • SIGMETs • NAS Status Advisories • Taxi Instructions • RVR/RVV Departure info (2-8-2 FAA Order 7110.65P) • Low Level Wind Shear/Microburst Advisories (3-1-8 FAA Order 7110.65P)	Table D-2
	C.1.1.2.2.1 Transceive On-Ground Aircraft to ATS Message	• Requests • Clearance/Instruction Responses • Emergency/Urgency Declarations • Contact Messages (providing frequency) • ATIS Requests • Position Reports • Intent Data	Table D-2
3	C.1.1.1.2.2 Transceive ATS to Vehicles Message	• Aircraft on Runway • Clearance Instructions • Operational Request (2-1-18 FAA Order 7110.65P) • Use of Active Runway (FAA Order 7110.65P) • Ground Traffic Movement (FAA Order 7110.65P) • Taxi and Ground Movement Operations (FAA Order 7110.65P)	Table D-3
	C.1.1.2.2.2 Transceive Vehicle to ATS Message	• Emergency vehicles tower responding to alert • Maintenance personnel crossing runway • Operational Request (2-1-18 FAA Order 7110.65P)	Table D-3
4	C.1.1.3.1.1 Transceive Internal NAS ATS Intrafacility Message	• Handoff or pointout (cut corner of another sector) • Flow Control Instructions • Flight coordination • Runway Status (3-1-12 FAA Order 7110.65P)	Table D-4
5	C.1.1.3.1.2 Transceive Internal NAS ATS Interfacility Message	• Flow Control Instructions • Flight coordination • Handoff (FAA Order 7110.65) • Operational Request (2-1-18 FAA Order 7110.65P) • Flight Plan Message	Table D-5

	Information Type (incl corresponding function ID)	Message Examples	Hazard Table Cross Reference
6	C.1.1.3.2.1 Transceive NAS ATS to OGA Message	• DoD • Law Enforcement • National Weather Service: • National Aeronautics and Space Administration (NASA) • Rescue Coordination Center (RCC) (Search and Rescue) • Homeland Security • State Department • Airport Authority • Fire Department	Table D-6
	C.1.1.3.2.2 Transceive OGA to NAS ATS Message	• DoD • Law Enforcement • National Weather Service: • NASA • RCC (Search and Rescue) • Homeland Security • State Department • Airport Authority • Fire Department	Table D-6
7	C.1.1.3.2.3 Transceive NAS ATS to Foreign ATS Message	• Flight Plan Information 2-2-13 FAA Order 7110.65P) • Flight Coordination Information	Table D-7
	C.1.1.3.2.4 Transceive Foreign ATS to NAS ATS Message	• Flight Plan Information • Flight Coordination Information	Table D-7
8	C.1.1.3.2.5 Transceive NAS ATS to non-NAS or non-OGA Message	AOC • Flight plan information • Flow control information • Emergency Declarations	Table D-8
	C.1.1.3.2.6 Transceive Non-NAS or non-OGA to NAS ATS Message	AOC • Emergency Declarations • Flight Plan Information • Flight Coordination Information • Schedule Information	Table D-8
9	C.1.1.4.1.1 Transceive Airborne Aircraft to Airborne Aircraft Message	• Position Data (e.g., UNICOM) • Party-line • Relay messages • Intent information • Advisory Messages	Table D-9
10	C.1.1.4.2.1 Transceive Airborne Aircraft to On-Ground Aircraft Message	ATC could ask an Airborne Aircraft to relay a message or request to an aircraft at the surface of a Satellite Airport if out of the Radio Frequency (RF) Line-of-Site (LOS).	Table D-9
	C.1.1.4.3.1 Transceive On-Ground Aircraft to Airborne Aircraft Message	Surface Aircraft at Satellite airport sends a message to be relayed via airborne aircraft to ATC.	Table D-9
11	C.1.1.4.2.2 Transceive Airborne Aircraft to Vehicles Message	No NAS ATS messages exchanged.	None
	C.1.1.4.3.2 Transceive Vehicles to Airborne Aircraft Message	No NAS ATS messages exchanged.	None
12	C.1.1.4.4.1 Transceive On-Ground Aircraft to On-Ground Aircraft Message	Advisory Messages (e.g., If an aircraft notices structural or other anomaly such as fluid from another aircraft during taxi, the pilot could report his observations to the surface aircraft.)	Table D-9
13	C.1.1.4.4.2 Transceive On-Ground Aircraft to Vehicle Message	No NAS ATS messages exchanged.	None

	Information Type (incl corresponding function ID)	Message Examples	Hazard Table Cross Reference
	C.1.1.4.4.3 Transceive Vehicle to On-Ground Aircraft Message	No NAS ATS messages exchanged.	None
	C.1.1.4.4.4 Transceive Vehicle to Vehicle Message	No NAS ATS messages exchanged.	None

D.2   Hazard Analysis Worksheets

For each of the hazards identified for the NAS Communication System, the potential causes of the hazard were listed. The system state was also identified. The system state used is the state that fosters the worst credible outcome. The Safety Hazard Analysis was captured in the tabular format in Table D-2 - Table D-9. The columns shown in each of the in the Safety Hazard Analysis tables are defined as follows:

- Column 1 – Hazard Identification: unique tag used to identify each hazard;
- Column 2 – Hazard Description: description of the hazard;
- Column 3 – Causes: list of potential causes that could result the hazard occurring;
- Column 4 – Risk/RAC: using the risk determination symbology outlined in section 2.2.3 of this report, this column provides the worst possible credible effect and the likelihood of that effect should the hazard occur.
- Column 5 – Potential Effects: provides a scenario leading to the worst credible effect if the hazard occurs.
- Column 6 – Existing Controls – identifies current procedures, environment, requirements, etc. that: 1) reduce the probability of occurrence of the hazard, 2) limit the severity, and/or 3) reduce the likelihood of occurrence of the WCE.
- Column 7 – Recommended Safety Requirements – identifies the safety requirements that must be implemented by program to meet the identified Risk/RAC for each hazard.
- Column 8 – Comments: provides additional rational for the resulting Risk/RAC.

D.3   NAS ATS - Aircraft Hazards

The section presents the 15 identified NAS Communication System hazards as they apply to messages exchanged between a NAS ATS and an aircraft. The aircraft may be either airborne or on the ground. Hazard 1 is split into 2 cases (1a and 1b) to distinguish between total and partial loss of ATS ground communication. Table D-2 contains the hazard analysis worksheet for the following functions:

- C.1.1.1.1.1 Transceive ATS to Airborne Aircraft Message,
- C.1.1.1.2.1 Transceive ATS to On-Ground Aircraft Message,
- C.1.1.2.1.1 Transceive Airborne Aircraft to ATS Message, and
- C.1.1.2.2.1 Transceive On-Ground Aircraft to ATS Message.

The system state leading to the worst credible effect (WCE) is the same for all ATS-Aircraft hazards due to the NAS Communication System:

- Heavy traffic conditions, and
- Instrument Meteorological Conditions (IMC) and/or
- Adverse weather conditions.

The hazards analysis in Table D-2 assumes only a single failure – NAS ATS - aircraft. Aircraft-to-aircraft communications is still considered available. See Table D-9 for the hazard assessment when both NAS ATS-aircraft and aircraft-aircraft communication have failed.

Table D-2: NAS ATS - Aircraft Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS-Aircraft COMM-1a	NAS ATS-Aircraft Communication Capability Totally Unavailable - Ground (Facility Wide) Ground cannot send/ receive messages to any aircraft	1. Hardware failure 2. Software Failure 3. RF Interference	3D	**Case 1:** Controller needs to issue new/amended clearances to several aircraft. When trying to transmit clearances, controller is informed that messages cannot be transmitted (voice nor data available). OR Controller knows in advance that NAS aircraft communications is unavailable. Controller transfers control to another control facility This could result in a significant increase in controller workload. This could also cause a slight increase in aircrew workload; but some could be time critical decisions. Significant reduction in air traffic capability	The air-ground Terminal Communications (TCOM) and En Route Communications (ECOM) communication shall be in accordance with Communication Diversity Order 6000.36A The NAS shall provide air-ground communications capabilities on a continuous basis. (NAS-SR-1000 3.6.1.E) The air-ground communication system shall comply with Critical services performance requirements: Availability - 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness*, Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-	*none*	*Notes: Aircraft may or may not be aware of ground failure (e.g., until aircraft attempts a transmission and it is not acknowledged)*

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				Case 2: Aircrew attempts to send clearance response and finds out he/she is unable to do so. Both current and new clearances are protected. Workload remains within expected workload so no hazard. **Case 3:** Aircraft diverts from route and aircrew attempts to send message indicating diversion and finds out he/she is unable to do so. Airspace is **NOT** protected and results in potential conflict. Ground system realizes aircraft position from surveillance information, out-of-conformance alert, or conflict alert. Controller cannot contact aircraft and must transfer control to another control facility to move the aircraft in conflict with the diverting aircraft. This could result in a significant increase in controller workload This could also cause a slight increase in aircrew workload; but some could be time critical decisions Significant reduction in air traffic capability.	ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) Aircraft-to-aircraft communications remains available (airborne or on-ground) ATC procedures to transfer communication functions (after communication failure) to other positions/sectors/facilities are prescribed. (FAA Order 7110.65, 10-4-4) Possible alternative communications capabilities (e.g., cell phone, public telephone, AOC, satellite phone when available relay (neighboring facility). Local SOP tailored to that facility and good operating procedures or FAA Order 7110.65P Effective Data August 4, 2005 Chapter 10 Emergencies section 1 General 10-1-1d. Traffic Alert and Collision Avoidance System (TCAS) is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)		
NAS ATS-Aircraft COMM-1b	NAS ATS-Aircraft Communication Capability Totally Unavailable - Ground (a given sector/control position) Ground (sector) cannot send/ receive messages to any aircraft	1. Hardware failure 2. Software Failure 3. RF Interference	**3D**	**Case 1:** Controller needs to issue new/amended clearances to several aircraft. When trying to transmit clearances, controller is informed that messages cannot be transmitted (voice nor data available). *OR* Controller knows in advance that NAS aircraft communications is unavailable.	The air-ground TCOM and ECOM communication shall be in accordance with Communication Diversity Order 6000.36A The NAS shall provide air-ground communications capabilities on a continuous basis. (NAS-SR-1000 3.6.1.E) The air-ground communication system shall comply with Critical services performance requirements: Availability - 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a	*none*	*Notes:* *Aircraft may or may not be aware of ground failure (e.g., until aircraft attempts a transmission and it is not acknowledged)*

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				Controller transfers control to another sector This could result in a significant increase in controller workload. This could also cause a slight increase in aircrew workload; but some could be time critical decisions. Significant reduction in air traffic capability OR **Case 2:** Aircrew attempts to send clearance response and finds out he/she is unable to do so. Both current and new clearances are protected. Workload remains within expected workload so no hazard. OR **Case 3:** Aircraft diverts from route and aircrew attempts to send message indicating diversion and finds out he/she is unable to do so. Airspace is **NOT** protected and results in potential conflict. Ground system realizes aircraft position from surveillance information, out-of-conformance alert, or conflict alert. Controller cannot contact aircraft and must transfer control to another control facility to move the aircraft in conflict with the diverting aircraft. This could result in a significant increase in controller workload This could also cause a slight increase in aircrew workload; but some could be time critical decisions Significant reduction in air traffic capability.	single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness,* Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) Aircraft-to-aircraft communications remains available (airborne or on-ground) ATC procedures to transfer communication functions (after communication failure) to other positions/sectors/facilities are prescribed. (FAA Order 7110.65, 10-4-4) Possible alternative communications capabilities (e.g., cell phone, public telephone, AOC, satellite phone when available relay (neighboring facility). Local SOP tailored to that facility and good operating procedures or FAA Order 7110.65P Effective Data August 4, 2005 Chapter 10 Emergencies section 1 General 10-1-1d. TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)		*This could be the loss of communication for a sector within a facility.*

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS-Aircraft COMM-2	NAS ATS-Aircraft Communication Capability Partially Unavailable – Ground Ground cannot send/ receive messages to one or more aircraft	1. Hardware failure 2. Software Failure 3. RF Interference	3D	**Case 1:** Controller needs to issue new/amended clearances to several aircraft. When trying to transmit the clearances, controller is informed that messages cannot be transmitted to all required aircraft. *OR* Controller knows in advance that NAS communications is unavailable to some of the aircraft Controller must revert to transmitting clearances via alternative means (e.g., alternate frequency, transferring to another sector or relay) This could result in a significant increase in controller workload This could also cause a slight increase in aircrew workload Significant reduction in air traffic capability *OR* **Case 2:** Aircrew attempts to send clearance response. Both current and new clearances are protected. Workload remains within expected workload so no hazard *OR* **Case 3:** Aircraft diverts from route and aircrew attempts to send message indicating diversion and finds out he/she is unable to do so. Airspace is **NOT** protected and results in potential conflict. Ground system realizes aircraft position from surveillance information, out-of-conformance alert, or conflict alert. Controller cannot contact aircraft and must transfer control to another sector or control facility to move the aircraft in conflict with the diverting aircraft. This could result in a significant increase in controller workload This could also cause a slight increase in aircrew workload; but some could be time critical decisions Significant reduction in air traffic capability.	The air-ground TCOM and ECOM communication shall be in accordance with Communication Diversity Order 6000.36A The NAS shall provide air-ground communications capabilities on a continuous basis. (NAS-SR-1000 3.6.1.E) The air-ground communication system shall comply with Critical services performance requirements: Availability - 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness,* Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) Aircraft-to-aircraft communications remains available (airborne or on-ground) ATC procedures to transfer communication functions (after communication failure) to other positions/sectors/facilities are prescribed. (FAA Order 7110.65, 10-4-4)	*none*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					Possible alternative communications capabilities (e.g., cell phone, public telephone, AOC, satellite phone when available. relay - ATC can instruct some aircraft concerning those he can't get to - neighboring sector controller or facility - ATC able to transmit command clearances and receive pilot feedback via equipment other than com radio (e.g., transponder, navigation radio) (FAA Order 7110.65, 10-4-4, 3-2-1, FARs 91.215, 91.205) - Communications capability on emergency frequency TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)		
NAS ATS-Aircraft COMM-3	NAS ATS-Aircraft Communication Capability Unavailable -Aircraft (single aircraft) Aircrew cannot send/ receive messages to ground	1. Hardware failure 2. Software Failure 3. Insufficient coverage 4. RF Interference	4C	Aircrew needs to request new/amended clearance. When trying to request the new clearance, aircrew determines that message cannot be transmitted *OR* Aircrew knows in advance that NAS aircraft-ground communications are unavailable Aircrew must use alternative means of communication (e.g., relay) This may cause a slight increase in aircrew workload This results in an increase in controller workload moving other aircraft Slight reduction in air traffic capability due to use of alternative procedures.	The air-ground TCOM and ECOM communication shall be in accordance with Communication Diversity Order 6000.36A The air-ground communication system shall comply with Critical services performance requirements: Availability - 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness,* Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a) Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-	*none*	*This could be one or all aircraft; but considered independent between aircraft.*

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					1.) Aircraft-to-aircraft communications remains available (airborne or on-ground) ATC procedures to transfer communication functions (after communication failure) to other positions/sectors/facilities are prescribed. (FAA Order 7110.65, 10-4-4) Possible alternative communications capabilities (e.g., cell phone, public telephone, AOC, satellite phone when available relay (neighboring facility). Local SOP tailored to that facility and good operating procedures or FAA Order 7110.65P Effective Data August 4, 2005 Chapter 10 Emergencies section 1 General 10-1-1d. ATC able to transmit command clearances and receive pilot feedback via equipment other than com radio (e.g., transponder, navigation radio) (FAA Order 7110.65, 10-4-4, 3-2-1, FARs 91.215, 91.205) TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)		
NAS ATS-Aircraft COMM-4	Message fails with a given aircraft	1. ground message (or part) does not make it to aircraft 2. aircraft message (or part) does not make it to ground	4C	Controller issues a new clearance Controller does not receive response to clearance; either the aircrew did not receive the clearance; or the aircrew received the clearance and response is lost. There is an ambiguity of whether the aircraft is executing the current or new clearance. However; both the current and new clearances are protected. This results in increased controller workload in resolving the situation (e.g., retransmitting the message) Slight loss of air traffic control capability in the affected area	The air-ground TCOM and ECOM communication shall be in accordance with Communication Diversity Order 6000.36A The air-ground communication system shall comply with Critical services performance requirements: Availability - 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness,* Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) Procedures requiring "pilot acknowledgement/read back" when ATC issues clearances or instructions (FAA Order 7110.65, 2-4-3). Controllers can also determine aircraft action through surveillance; IDENT, observing radar screen. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) Controllers are required to order a clearance such that the critical information cannot be lost due to a failure truncating a message. Air-to-air communications still available, so another aircrew may	*none*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					hear a step on or incorrect read-back and notify, and/or aircraft can announce intentions on party line Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) . "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113. TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18).		
NAS ATS-Aircraft COMM-5	Message fails with multiple aircraft	1. ground message (or part) does not make it to aircraft 2. aircraft message (or part) does not make it to ground.	4C	Controller issues new clearances to multiple aircraft. Controller does not receive response to the clearances; either the aircrew did not receive the clearance; or the aircrew received the clearance and responses are lost There is an ambiguity of whether the aircraft are executing the current or new clearances. However; both the current and new clearances are protected. This results in a significant increased controller workload in resolving the situation with multiple aircraft (e.g., retransmitting the message) Slight reduction in air traffic capability	The air-ground TCOM and ECOM communication shall be in accordance with Communication Diversity Order 6000.36A The air-ground communication. system shall comply with Critical services performance requirements: Availability - 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness,* Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) Procedures requiring "pilot acknowledgement/read back" when ATC issues clearances or instructions (FAA Order 7110.65, 2-4-3) Controllers can also determine aircraft action through surveillance; IDENT, observing radar screen. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) Controllers are required to order a clearance such that the critical information cannot be lost due to a failure truncating a message. Air-to-air communications still available, so another aircrew may hear a step on or incorrect read-back and notify, and/or aircraft can announce intentions on party line Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) "See and Avoid" procedures are prescribed. (Aeronautical	*none*	

2006| Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
			 		Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)		
NAS ATS-Aircraft COMM-6	The aircraft acts on messages affecting separation (e.g., a clearance) from a ground system that is not its control authority	An unauthorized ground system sends a messages affecting separation	2D	Aircrew accepts a clearance from a ground system not in control of the aircraft The controlling authority is unaware of the clearance; and consequently the airspace is not protected This could result in a loss of separation. The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separation. Resolving the loss of separation could cause time critical aircrew decisions and excessive increased workload	Procedures requiring aircraft identification for clearance (FAA Order 7110.65, 2-4-20) - Call sign/runway id (not shortened call sign) - Procedures for identification of the aircraft requesting clearances - Procedures for giving aircraft ID in granting clearances Procedures requiring Facility Identification (FAA Order 7110.65, 2-4-8) for the ATC facility giving the clearances. ICAO Annex 11: paragraph 3.5.1 "A controlled flight shall be under the control of only one air traffic control unit at any given time." - The aircraft shall accept clearances/instructions only from the current control authority Adjacent frequencies have different frequencies. Procedures requiring "pilot acknowledgement/read back" when ATC issues clearances or instructions (FAA Order 7110.65, 2-4-3) Controllers can also determine aircraft action through surveillance; IDENT, observing radar screen. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) Current separation standards. (FAA order 7110.65) Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*none*	
NAS ATS-Aircraft COMM-7	The aircraft accepts messages NOT affecting separation from a ground system that is not its control authority	An unauthorized ground system sends a messages NOT affecting separation	5	Aircrew accepts a message that does not affect separation from a ground system not in control of the aircraft Time may be spent responding to a message that that does not apply This does not result in a loss of separation.	*Not addressed since no hazard.*	*None*	
NAS ATS-Aircraft COMM-8	A message affecting separation is acted on by an unintended recipient	1. Address is corrupted 2. Mis-delivered 3. Step-on	2D	**Case 1:** A clearance is transmitted and reaches an unintended aircraft. The aircrew does not realize that the clearance is not for them and accepts the clearance.	Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) .	*none*	

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Hazard #	Hazard Description	Causes	Risk/RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				(When the unintended recipient is not under the control authority see NAS ATS-Aircraft COMM-6.) Upon receipt of the WILCO to the clearance, the controller: a) does not realize that the WILCO is from a different aircraft than the intended one or b) the controller realizes that the WILCO is from an unintended aircraft. (The difference between case a and case b; is just how soon the controller realizes that there is a situation that needs resolution.) In either case, the airspace is not protected and could result in a loss of separation The loss of separation could result in large reductions in safety margins Resolving the situation could also result in increased ATC workload due to having to move several aircraft. to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and increased workload **Case 2**: The response to a clearance is sent and reaches an unintended ground system. The unintended ground system receives a message that is unexpected; but is no more than a nuisance. The ground system that should have received the response message; does not receive any message; and the clearance message expires. See NAS ATS-Aircraft COMM-10.	Air-to-air communications still available, so other aircrew may hear wrong aircraft accept clearance and notify the aircraft The intended recipient is also listening so he/she may query or chime in (party line) Procedures requiring aircraft identification for clearance (FAA Order 7110.65, 2-4-20) - Call sign/runway id (not shortened call sign) - Procedures for identification of the aircraft requesting clearances - Procedures for giving aircraft ID in granting clearances Procedures requiring "pilot acknowledgement/read back" when ATC issues clearances or instructions (FAA Order 7110.65, 2-4-3) Controllers can also determine aircraft action through surveillance; IDENT, observing radar screen. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) Voice procedures: - Procedures for giving aircraft ID in granting clearances - Procedures for communication when aircraft have same or similar call signs The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)		
NAS ATS-Aircraft COMM-9	A message NOT affecting separation is acted on by an unintended recipient	1. Address is corrupted 2. Mis-delivered 3. Step-on	5	**Case 1**: A message NOT affecting separation reaches an unintended aircraft. The aircrew does not realize that the message is not for them and acts on it. If the message requires a response, upon receipt of the response, the controller: a) does not realize that the response is from a different aircraft than the intended one or b) the controller realizes that the response is from an unintended aircraft. If the message does not require a response; the controller may not be aware that message went to an unintended recipient, unless flight crew expecting a message, queries for missing message. This does not result in a loss of separation At most this could result in a slight increase in ATC workload due to either resending message to the intended aircraft. In general this would be well within the normal workload.	*Not addressed since no hazard.*	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				There may be a slight increase in aircrew workload (of the unintended aircraft) in responding to a message not applicable to them. In general this would be well within the normal workload. **Case 2**: A request message reaches an unintended ground system. The controller does not realize that request is not for them and responds with a clearance. This ground system is not the control authority of the aircraft. See NAS ATS-Aircraft COMM-6.			
NAS ATS-Aircraft COMM-10	A message affecting separation received too late (or expired) Applicable only to data link.	1. Late delivery 2. Ground and air time is out of synch	2D	Clearance is sent and expires before a response is received. *or* Aircrew accepts a clearance after it has expired. The controller reverts to alternate solution due to the clearance expiry; and the airspace of the new clearance is no longer protected. This could result in a loss of separation The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft. Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload	Voice and data communications shall have the following response capabilities: --Initiation of one-way air-ground voice transmissions shall be possible within 250 milliseconds of keying the specialist's microphone. --The ground-air transmission time for data messages shall not exceed 6 seconds. (NAS-SR-1000 3.6.1.A.5) Time critical clearance can be sent with constraint (e.g. to reach by, cross at or before etc.). Thus if message was too late then aircrew would have send an UNABLE response. FAA Order 7110.65P (Chapter 4, Section 3 Departure Procedures 4-3-4 a. Clearance Void Times). ADS report (surveillance) can provide aircraft position. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) CPDLC pilot position reports can provide aircraft position Oceanic separation standards. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 8 Offshore/Oceanic Procedures) Data link Messages are times tamped The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*none*	*So far no incidents due to this*
NAS ATS-Aircraft COMM-11	A message NOT affecting separation received too late or expired Applicable only to data link.	1. Late delivery 2. Ground and air time is out of synch	5	**Case 1:** A message not affecting separation is transmitted and expires before a response is received. The controller reverts to alternate solution due to the messages expiry. Aircrew responds to message after it has expired. Since the expired message does not affect separation, this does not result in a loss of separation	*Not addressed since no hazard.*	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				At most this could result in a slight increase in ATC workload due to either retransmitting the message. In general this would be well within the normal workload. There may be a slight increase in aircrew workload. In general this would be well within the normal workload. **Case 2:** A request message is transmitted and expires before a response is received. At most this could result in a slight increase in aircrew workload due to retransmitting the request message. In general this would be well within the normal workload.			
NAS ATS-Aircraft COMM-12	A message affecting separation is corrupted	The communication system corrupts the message	2D	**Case 1:** A clearance is sent and the contents are corrupted, but still credible. The aircrew accepts the corrupted clearance. Since the clearance has been corrupted its airspace is be not protected. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft. to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload. **Case 2:** The response to clearance is sent and the contents are corrupted, but still credible. (readback is corrupted and credible) Once the clearance response has been received; either the old clearance airspace or the new clearance airspace becomes unprotected; but it is precisely the opposite of what the aircraft is doing. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical	Clearly intelligible air-ground voice communications shall be provided. (NAS-SR-1000 3.6.1.A) Procedures requiring Emphasis for Clarity (FAA Order 7110.65, 2-4-15) Procedures requiring "pilot acknowledgement/read back" when ATC issues clearances or instructions (FAA Order 7110.65, 2-4-3) Controllers can also determine aircraft action through surveillance; IDENT, observing radar screen. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) Air-to-air communications still available, so another aircrew may hear an incorrect read-back and notify, and/or aircraft can announce intentions on party line Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				aircrew decisions and excessively increased workload. **Case 3:** The address/call sign is the part of the message that becomes corrupted. See Hazard NAS-G-M-COMM-8.			
NAS ATS-Aircraft COMM-13	A message NOT affecting separation corrupted	The communication system corrupts the message	5	**Case 1:** A message not affecting separation is transmitted and the contents are corrupted, but still credible. At most this could result in a slight increase in ATC workload due to retransmitting a message. In general this would be well within the normal workload. There may be a slight increase in aircrew workload in responding to a corrupted message. In general this would be well within the normal workload. **Case 2:** A request is sent and the contents are corrupted, but still credible. The ground responds with a clearance meeting the corrupted request message. The airspace is the clearance is protected so this does not result in a loss of separation There may be a slight increase in aircrew workload if they send a second request. In general this would be well within the normal workload.	*Not required.*	*None*	
NAS ATS-Aircraft COMM-14	A message affecting separation sent/received out of sequence. Applicable only to data link.	1. Message sent second is received prior to message sent first. 2. Communication system does not deliver messages in order	4D	**Case 1:** Two (or more) clearances are transmitted and do not arrive in the order in which they were sent. This could result in an aircraft executing a clearance out of order; and the airspace may not be protected. The loss of separation could result in large reductions in safety margins Resolving the situation could also result in increased ATC workload due to having to move several aircraft. to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and increased workload. Case 2: Two (or more) responses to clearances are sent and do not arrive in the order in which they were sent. All clearances response messages referenced to the clearance to which they apply. Therefore, if they are received out of order there is no impact.	Messages are time-stamped; so order can be determined Only one Pre-Departure Clearance (PDC) is sent (thus cannot get out of order) Data link response message indicate to which message they refer	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS-Aircraft COMM-15	A message NOT affecting separation sent/received out of sequence. Applicable only to data link.	1. Message sent second gets received prior to message sent first. 2. Communication system does not deliver messages in order	5	**Case 1:** Two (or more) messages are sent not affecting separation and do not arrive in the order in which they were sent. If the messages are different, there may be a slight increase in aircrew workload figuring thing out. In general this would be well within the normal workload. **Case 2:** Two (or more) requests are sent and do not arrive in the order in which they were sent. If the requests are different, there may be some increased workload for both the air and ground in determining which clearance the aircrew wants to fly.	*Not required*	*None*	

D.4 NAS ATS - Vehicle Message Hazards

This section presents the 15 identified NAS communication hazards as they apply to messages exchanged between a NAS ATS and a vehicle. Hazard 1 is split into 2 cases (1a and 1b) to distinguish between total and partial loss of NAS ATS communication. Table D-3 maps to the following NAS communication functions:

- C.1.1.1.2.2 Transceive ATS to Vehicles Message and
- C.1.1.2.2.2 Transceive Vehicle to ATS Message

The system state leading to the worst credible effect (WCE) is the same for all 15 ATS-vehicle hazards due to the NAS Communication System:

- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions.

Table D-3: NAS ATS - Vehicles Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS-Vehicles COMM-1a	NAS ATS Vehicle Communication Capability Totally Unavailable - Tower Ground cannot send/ receive messages to any vehicle	1. Hardware failure 2. Software Failure 3. RF Interference	4E	Controller needs to issue clearance to vehicle. When trying to transmit clearances, controller is informed that messages cannot be transmitted (voice nor data available). OR Controller knows in advance that NAS ground-mobile communications is unavailable.	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				This could cause an inconvenience to the vehicle operators.	139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) Vehicle operation training/ licensing for airport operations Part 139.329(e) requires that "each certificate holder shall -- ensure that each employee, tenant, or contractor who operates aground vehicle on any portion of the airport that has access to the movement area is familiar with the airport's procedures for the operation of ground vehicles and the consequences of noncompliance." To comply with Part 139.329(e), airport operators should have a ground vehicle guidebook for training personnel authorized to operate a ground vehicle on the airport. Part 139.301 Records – ground vehicle training; 139.303 Personnel Sufficient Qualified Personnel (303a), Properly Equipped (303b), Trained (303c), Record of Training for 24 CCM (303d) Vehicles all yield to aircraft: AC 150/5210-20 Ground Vehicle Operations on Airports - guidance to airport operators in developing training programs for safe ground vehicle operations, Sample Ground Vehicle Operations Training Manual Appendix B 1.7.10. No vehicle operator shall enter the movement area— a. Without first obtaining permission of the (AIRPORT OPERATOR) and clearance from the ATCT to enter the movement area; b. Unless equipped with an operable two-way radio in communication with the ATCT; or c. Unless escorted by an (AIRPORT OPERATOR) vehicle and as long as the vehicle remains under the control of the escort vehicle. See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] Vehicles under visual surveillance or radar/multi-lateration surveillance: FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, "Use of Active Runways," states, "The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways." Paragraph 3-1-12, "Visually Scanning Runways," states that, "Local controllers shall visually scan runways to the maximum extent possible." The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D).		

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					Mobile-to mobile communications still available

FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways.

FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible.

The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F)

Possible alternative communications capabilities (e.g., cell phone, public telephone, AOC, satellite phone when available relay (neighboring facility). Local SOP tailored to that facility and good operating procedures or FAA Order 7110.65P Effective Data August 4, 2005 Chapter 10 Emergencies section 1 General 10-1-1d.

Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR Part 139] requirement to familiarize vehicles for operating on a given airport.

CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area.

CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM). | | |
| NAS ATS-Vehicles COMM-1b | NAS ATS-Vehicle Communication Capability Totally Unavailable - Ground (a given position)

Ground cannot send/ receive messages to any vehicle | 1. Hardware failure 2. Software Failure 3. RF Interference | 4E | Controller needs to issue new/amended clearance to vehicle.

When trying to transmit clearances, controller is informed that messages cannot be transmitted (voice nor data available).
    OR
Controller knows in advance that NAS ground-mobile communications is unavailable.

This could cause an inconvenience to the vehicle operators. | Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design)

AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems."

Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC.

Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185)

Vehicle operation training/ licensing for airport operations Part 139.329(e) requires that "each certificate holder shall -- ensure that each employee, tenant, or contractor who operates aground | *None* | |

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					vehicle on any portion of the airport that has access to the movement area is familiar with the airport's procedures for the operation of ground vehicles and the consequences of noncompliance." To comply with Part 139.329(e), airport operators should have a ground vehicle guidebook for training personnel authorized to operate a ground vehicle on the airport. Part 139.301 Records – ground vehicle training; 139.303 Personnel Sufficient Qualified Personnel (303a), Properly Equipped (303b), Trained (303c), Record of Training for 24 CCM (303d) Vehicles all yield to aircraft: AC 150/5210-20 Ground Vehicle Operations on Airports - guidance to airport operators in developing training programs for safe ground vehicle operations, Sample Ground Vehicle Operations Training Manual Appendix B 1.7.10. No vehicle operator shall enter the movement area— a. Without first obtaining permission of the (AIRPORT OPERATOR) and clearance from the ATCT to enter the movement area; b. Unless equipped with an operable two-way radio in communication with the ATCT; or c. Unless escorted by an (AIRPORT OPERATOR) vehicle and as long as the vehicle remains under the control of the escort vehicle. See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] Vehicles under visual surveillance or radar/multi-lateration surveillance: FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, "Use of Active Runways," states, "The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways." Paragraph 3-1-12, "Visually Scanning Runways," states that, "Local controllers shall visually scan runways to the maximum extent possible." The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). Mobile-to mobile communications still available FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways. FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible. The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement		

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) Possible alternative communications capabilities e.g., cell phone, ATCT light gun procedures Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR Part 139] requirement to familiarize vehicles for operating on a given airport. CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area. CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).		
NAS ATS-Vehicles COMM-2	NAS ATS-Vehicles Communication Capability Partially Unavailable – Ground Ground cannot send/ receive messages to one or more vehicles	1. Hardware failure 2. Software Failure 3. Insufficient capacity 4. RF Interference	4E	Controller needs to issue new/amended clearances to vehicle. When trying to transmit the clearances, controller is informed that messages cannot be transmitted to all required vehicles. OR Controller knows in advance that NAS communications is unavailable to some of the vehicles This could cause an inconvenience to the vehicle operators.	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] Vehicles under visual surveillance or radar/multi-lateration surveillance: FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, "Use of Active Runways," states, "The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways." Paragraph 3-1-12, "Visually Scanning Runways," states that, "Local controllers shall visually scan runways to the maximum extent possible." The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). Mobile-to mobile communications still available	None	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways. FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible. The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) Possible alternative communications capabilities e.g., cell phone, ATCT light gun procedures Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR Part 139] requirement to familiarize vehicles for operating on a given airport. CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area. CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).		
NAS ATS-Vehicles COMM-3	NAS ATS-Vehicle Communication Capability Unavailable due to the Vehicle (single vehicle) Vehicle cannot send/ receive messages to ground	1. Hardware failure 2. Software Failure 3. Insufficient capacity 4. RF Interference	4D	Vehicle operator needs to request new/amended clearance. When trying to request the new clearance, the vehicle operator determines that messages cannot be transmitted OR Vehicle operator knows in advance that NAS ATS-vehicle communications are unavailable Vehicle operator must alternative means (e.g., cell phone) This could cause an inconvenience to the vehicle operators.	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] Vehicles under visual surveillance or radar/multi-lateration	None	Note: This could affect more than one vehicle; but considered independent.

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					surveillance: FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, "Use of Active Runways," states, "The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways." Paragraph 3-1-12, "Visually Scanning Runways," states that, "Local controllers shall visually scan runways to the maximum extent possible."		
					The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D).		
					Mobile-to mobile communications still available		
					FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways.		
					FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible.		
					The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F)		
					Possible alternative communications capabilities e.g., cell phone, ATCT light gun procedures		
					Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR Part 139] requirement to familiarize vehicles for operating on a given airport.		
					CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area.		
					CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).		
NAS ATS-Vehicles COMM-4	Message fails with a given vehicle	1. ATS message (or part) does not make it to vehicle 2. Vehicle operator's message (or part) does not make it to the ATS	4D	Controller issues a new clearance Controller does not receive response to clearance; either the vehicle operator did not receive the clearance; or the vehicle operator received the clearance and response is lost. There is an ambiguity of whether the vehicle operator is executing the current or new clearance. However; both the current and new clearances are protected. This results in slight increased controller workload in resolving the situation (e.g., retransmitting the message) This could cause an inconvenience to the vehicle operators.	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					failure Federal Aviation Regulations [FAR] 91.185)		
					See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113)		
					Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)]		
					Vehicles under visual surveillance or radar/multi-lateration surveillance: FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, "Use of Active Runways," states, "The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways." Paragraph 3-1-12, "Visually Scanning Runways," states that, "Local controllers shall visually scan runways to the maximum extent possible."		
					The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D).		
					Mobile-to mobile communications still available		
					FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways.		
					FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible.		
					The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F)		
					Possible alternative communications capabilities e.g., cell phone, ATCT light gun procedures		
					Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR Part 139] requirement to familiarize vehicles for operating on a given airport.		
					CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area.		
					CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).		
NAS ATS-Vehicles COMM-5	Message fails with multiple vehicles	1. ATS does not make it to vehicles 2. Vehicle operators' message (or part) does not make it to	4E	Controller issues new clearances to multiple vehicles

Controller does not receive response to the clearances; either the vehicle operators did not receive the clearances; or the vehicle operators received the clearance and | Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design)

AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC | None | |

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
		ATS.		responses are lost There is an ambiguity of whether the vehicle operators are executing the current or new clearances. However; both the current and new clearances are protected. This results in slight increased controller workload in resolving the situation (e.g., retransmitting the message) This could cause an inconvenience to the vehicle operators.	150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] Vehicles under visual surveillance or radar/multi-lateration surveillance: FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, "Use of Active Runways," states, "The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways." Paragraph 3-1-12, "Visually Scanning Runways," states that, "Local controllers shall visually scan runways to the maximum extent possible." The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways. FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible. Mobile-to mobile communications still available The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) Possible alternative communications capabilities e.g., cell phone, ATCT light gun procedures Title 14, Code of Federal Regulations (CFR), Part 139 (14 CFR Part 139] requirement to familiarize vehicles for operating on a given airport.		

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area. CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).		
NAS ATS-Vehicles COMM-6	The vehicle operator acts on messages affecting separation from a ground system that is not its control authority	An unauthorized ground system sends a messag affecting separation	2E	Vehicle operator accepts a clearance from a ground system that is not his control authority The controlling authority is unaware of the clearance; and consequently the clearance is not protected The non-controlling ground system unaware that is wrong vehicle. The loss of separation could result in large reductions in safety margins Resolving the situation could also result in increased ATC workload Resolving the loss of separation could cause time critical vehicle operator decisions	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Unique frequencies for control Call sign/runway id (not shortened call sign) See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Vehicle under visual surveillance or radar/multi-lateration surveillance Procedures for identification of the ATC facility giving the clearances Procedures for identification of vehicles requesting clearances (Part 139CFR ground vehicle guidebook for training) Controller procedures for giving vehicle ID in granting clearances (FAA Order 7110.65 Section 7 Taxi and Ground Movement Procedures 3-7-2 Taxi and Ground Movement Operations) Vehicle also gives current position when asking for permission to move Controllers must establish position before moving vehicle (FAA Order 7110.65 Section 1 General 3-1-7 Position Determination) FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways. FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible. The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D).	None	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS- Vehicles COMM-7	The vehicle operator accepts messages NOT affecting separation from a ground system that is not its control authority	An unauthorized ground system sends a message NOT affecting separation	5	Vehicle operator accepts a message that does not affect separation from a ground system not in control of the aircraft Time may be spent responding to a message that that does not apply. This could cause an inconvenience to the vehicle operators. This does not result in a loss of separation.	Not required.	None	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS- ATS-Vehicles COMM-8	A message affecting separation is acted on by an unintended recipient (undetected)	1. Address is corrupted 2. Mis-delivered 3. Step-on	2E	**Case 1:** A clearance is transmitted and reaches an unintended vehicle operator. The operator does not realize that the clearance is not for her/him and accepts the clearance. (When the unintended recipient is not under the control see NAS ATS-vehicles COMM-6.) Upon receipt of the WILCO to the clearance, the controller: a) does not realize that the WILCO is from a different vehicle operator than the intended one or b) the controller realizes that the WILCO is from an unintended vehicle operator. (The difference between case a and case b; is just how soon the controller realizes that there is a situation that needs resolution.) In either case, the movement area is not protected and could result in a loss of separation The loss of separation could result in large reductions in safety margins Resolving the situation could also result in increased ATC workload **Case 2**: The response to a clearance is sent and reaches an unintended ground system. The unintended ground system receives a message that is unexpected; but is no more than a nuisance. The ground system that should have received the response message; does not receive any message; and the clearance message expires. See NAS ATS-vehicles COMM-6.	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Controller use of full call sign/runway ID (not shortened) (FAA Order 7110.65P 3-7-1 Ground Traffic Movement *Phraseology)* See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Vehicle under visual surveillance or radar/multi-lateration surveillance The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). Controllers must establish position before moving vehicle (FAA Order 7110.65 Section 1 General 3-1-7 Position Determination) Procedures for identification of vehicles requesting clearances (Part 139CFR ground vehicle guidebook for training) Controller procedures for giving vehicle ID in granting clearances (FAA Order 7110.65 Section 7 Taxi and Ground Movement Procedures 3-7-2 Taxi and Ground Movement Operations) FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways. FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible. CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area. CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).	*None*	
NAS ATS-Vehicles COMM-9	A message NOT affecting separation is acted on by an unintended recipient.	1. Address is corrupted 2. Mis-delivered 3. Step-on	5	Unintended vehicle operator accepts a message that does not affect separation. Time may be spent responding to a message that that does not apply. This could cause an inconvenience to the vehicle	*Not required*	*None*	

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Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
			■	operators. This does not result in a loss of separation.			
NAS ATS-Vehicles COMM-10	A message affecting separation received too late (or expired) (Exclusive to data link)	NA in current environment					
NAS ATS-Vehicles COMM-11	A message NOT affecting separation received too late or expired) (Exclusive to data link)	NA in current environment					

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Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS-Vehicles COMM-12	A message affecting separation corrupted	The communication system corrupts the message	2E	**Case 1:** A clearance is sent and the contents are corrupted, but still credible. The aircrew accepts the corrupted clearance. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft/vehicles) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in increased ATC workload Resolving the loss of separation could cause time critical vehicle operator decisions and increased workload. **Case 2:** The response to clearance is sent and the contents are corrupted, but still credible. (readback corrupted) Once the clearance response has been received; either the old clearance movement area or the new clearance movement area becomes unprotected; but it is precisely the opposite of what the vehicle is doing. This could result in a loss of separation if the accepted corrupted clearance converges with other aircraft/vehicles The loss of separation could result in large reductions in safety margins Resolving the situation could also result in increased ATC workload Resolving the loss of separation could cause time critical vehicle operator decisions and increased workload. **CASE 3:** The address/call sign is the part of the message that becomes corrupted. See Hazard NASATS-Vehilces-COMM-18.	Airport design minimizes runway and taxiway crossing by vehicles. (AC 150/5300-13 Airport Design) AC 150/5340-18D Standards for Airport Sign Systems Part 139.311 CFR MARKING, SIGNS AND LIGHTING AC 150/5210-22 Airport Certification Manual (ACM): Paragraph 302(a) "Airport sign and marking plans must receive FAA approval before they are implemented" Chapter 5. Section 139.311 "Include in the ACM a legible color diagram of the airport sign and marking systems." Vehicles are only allowed to move (runways etc) when doesn't affect basic ATC. Call sign/runway id (not shortened call sign) See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113) Vehicle under visual surveillance or radar/multi-lateration surveillance The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). Procedures for identification of the ATC facility giving the clearances Procedures for identification of vehicles requesting clearances (Part 139CFR ground vehicle guidebook for training) Controller procedures for giving vehicle ID in granting clearances (FAA Order 7110.65 Section 7 Taxi and Ground Movement Procedures 3-7-2 Taxi and Ground Movement Operations) Vehicle readback procedures (voice) (Part 139CFR ground vehicle guidebook for training) FAA Order 7110.65, Air Traffic Control Handbook, paragraph 3-1-3, Use of Active Runways, - The local controller has primary responsibility for operations conducted on the active runway and must control the use of those runways. FAA Order 7110.65 Paragraph 3-1-12, Visually Scanning Runways - Local controllers shall visually scan runways to the maximum extent possible. CFR Part 139.329(b) airport operators are required to establish and implement procedures for operation of ground vehicles in the safety area as well as the movement area. CFR Part 139.205(b)(19) requires that these procedures be included in the Airport Certification Manual (ACM).	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS ATS-Vehicles COMM-13	A message NOT affecting separation corrupted (undetected)	The communication system corrupts the message	5	**Case 1:** A message not affecting separation is transmitted and the contents are corrupted, but still credible. At most this could result in a slight increase in ATC workload due to retransmitting a message. In general this would be well within the normal workload. There may be a slight increase in vehicle operator's workload in responding to a corrupted message. In general this would be well within the normal workload. **Case 2:** A request is sent and the contents are corrupted, but still credible. The ground responds with a clearance meeting the corrupted request message. There may be a slight increase in vehicle operator's workload if they send a second request. In general this would be well within the normal workload.	*Not required*	*None*	
NAS- ATS-Vehicles COMM-14	A message affecting separation sent/received out of sequence (only data link)	NA in current environment					
NAS- ATS-Vehicles COMM-15	A message NOT affecting separation sent/received out of sequence (only data link)	NA in current environment					

D.5 NAS ATS Intrafacility Message Hazards

The section presents the 15 identified NAS communication hazards as they apply to messages exchanged within a NAS facility (i.e., intrafacility messages). In the current NAS Communication System these hazards relate to failures with the intrafacility phone system. Table D-4 maps to the NAS communication function C.1.1.3.1.1, Transceive NAS ATS Intrafacility Message.

The system state leading to the worst credible effect (WCE) is the same for all NAS intrafacility hazards due to the NAS Communication System:
- HOST functional (automation working), and
- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions, and
- Situation outside of normal conditions (i.e., automation cannot handle) and thus requiring controller-to-controller coordination.

Table D-4: NAS Intrafacility Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Intra COMM-1	NAS Intrafacility Communication Capability Totally Unavailable - (known)	1. Hardware failure 2. Software Failure	5	Controller needs to coordinate with another controller within facility (transfer of a flight outside of what is automated) When attempting to call other controller; calling controller realizes phone system is not working Possible slight increase in workload to effect required communication; well within normal workload	Intrafacility communication requirements have been minimized due to automation of many functions Controller/ assistant/ supervisor can walk over and talk to other controller.	*None*	
NAS Intra COMM-2	NAS Intrafacility Communication Capability Partially Unavailable – (known)	1. Hardware failure 2. Software Failure 3. Insufficient capacity	5	Controller needs to coordinate with another controller within facility (transfer of a flight outside of what is automated) When attempting to call other controller; calling controller realizes cannot reach particular controller Possible slight increase in workload to effect required communication; well within normal workload	Intrafacility communication requirements have been minimized due to automation of many functions Controller/ assistant/ supervisor can walk over and talk to other controller	*None*	
NAS Intra COMM-3	*Covered in NAS Intra COMM-2 so N/A*						
NAS Intra COMM-4	NAS communication fails while communicating with another controller	a. hardware failure b. software failure 1. message (or part) does not make it to other controller 2. response message (or part) from other controller does not make it back to initiator.	2E	Controller needs to coordinate with another controller within facility (transfer of a flight outside of what is automated). The answer gets cuts off ("yes, but…"), and both controllers are unaware of failure Results in misleading information; where flight could have clearance from transferring controller that is different from clearance agreed to by receiving controller. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload.	Intrafacility communication requirements have been minimized due to automation of many functions Controller/ assistant/ supervisor can walk over and talk to other controller Voice messages would not get a proper acknowledgement, when truncated due to a failure (Procedure between interphone intra/interfacility communication which utilize numeric position identification, the caller must identify both position and facility (FAA Order 7110.65P 2-4-12 Interphone Message Format) e. The receiver states the response to the caller's message followed by the receiver's operating initials. f. The caller states his or her operating initials). Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Intra COMM-5	NAS communication fails while communicating with more than one controller	*NA*					
NAS Intra COMM-6	*NA*						
NAS Intra COMM-7	*NA*						
NAS Intra COMM-8	A message affecting separation is sent to unintended recipient	Mis-delivered	**5**	When calling another sector controller; the calling sector controller reaches an unintended controller. (The controller correctly inputs the number). Once start talking would realize wrong controller	Intrafacility communication requirements have been minimized due to automation of many functions Controller/ assistant/ supervisor can walk over and talk to other controller	*None*	
NAS Intra COMM-9	A message NOT affecting separation is sent to unintended recipient	Mis-delivered	**5**	When calling another sector controller; the calling sector controller reaches an unintended controller. (The controller correctly inputs the number). Once start talking would realize wrong controller	Intrafacility communication requirements have been minimized due to automation of many functions Controller/ assistant/ supervisor can walk over and talk to other controller	*None*	
NAS Intra COMM-10	*NA in current environment. Messages arriving too late do not apply to voice.*						
NAS Intra COMM -11	*NA in current environment. Messages arriving too late do not apply to voice.*						
NAS Intra COMM-12	A message affecting separation corrupted	The communication system corrupts the message	**2E**	Controller needs to coordinate with another controller within facility (transfer of a flight outside of what is automated). The message is corrupted, but credible Results in misleading information; where flight could have clearance from transferring controller that is different from clearance agreed to by receiving controller. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload.	Intrafacility communication requirements have been minimized due to automation of many functions Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*None*	
NAS Intra COMM -13	A message NOT affecting separation corrupted	The communication system corrupts the message	**5**	One controller provides information to another controller that does not affect separation Due to the communication system the message is corrupted, but credible. At most there may be additional workload, due to a need to re-communicate message; but this is well within the normal controller workload No safety affect	Intrafacility communication requirements have been minimized due to automation of many functions	*None*	
NAS- NAS Intra	*NA in current environment. Messages arriving out of sequence do not apply to voice.*						

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
COMM -14							
NAS- NAS Intra COMM -15	*NA in current environment. Messages arriving out of sequence do not apply to voice.*						

F.5   NAS ATS Interfacility Message

This section presents the 15 identified NAS communication hazards as they apply to messages exchanged between NAS facilities (interfacility messages). Table D-5 maps to the NAS communication function C.1.1.3.1.2, Transceive NAS ATS Interfacility Message.

The system state leading to the worst credible effect (WCE) is the same for all NAS interfacility hazards due to the NAS Communication System:
- HOST functional (automation working)
- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions, and
- Situation outside of normal conditions (i.e., automation cannot handle) and thus requiring controller to controller coordination.

Table D-5: NAS Interfacility Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS-Inter COMM-1	NAS Inter Facility Communication Capability Totally Unavailable - (known)	1. Hardware failure 2. Software Failure	4D	Controller needs to coordinate with a controller at another NAS facility (transfer of a flight outside of what is automated). Controller knows ahead of time or realizes when trying to contact another facility that there is complete loss of all NAS voice and data communications to any other facility Since air-ground communication is still available the transferring ground facility would direct the aircrew to contact the receiving facility directly for transfer instructions. Slight reduction in ATC capability Slight increase in aircrew workload	SR-1000: 3.6.2A 1: The NAS shall provide direct-access voice communications connectivity between specialist in on ATC facility and designated specialist in another facility as shown in Table 3-1. The number of direct-access calls that are blocked because of saturation of equipment shall not exceed 1 in 1000 calls. Air-ground communication remains available Redundancy to prevent interruption – centers can talk to multiple facilities (2 or 3 facilities typical) and command center Required communication between facilities has been minimized; most transfers of control are done automatically Diverse entry points into facilities. (Communication Diversity Order 6000.36A) Procedure to switch to emergency operational AT procedures. (FAA Order 7210.3 Facility Operation and Administration Section 3 Letters of Agreement (LOA) 4-3-1 Letters of Agreement; g. Establish responsibilities for: 2. Providing emergency services).	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					Procedure to switch to FAA-owned communications systems – FAATSAT transportable equip., RCL, portable air-ground radio. Other facility can be reached be other means (Local Contingency Plan – FAA Order 7210.3 Facility 2-1-7 Air Traffic Service (ATS) Continuity a. Facilities shall develop and maintain current operational plans and procedures to provide continuity of required services during emergency conditions (e.g. power failures, fire, flood) b. Contingency plans). · Relay through aircraft · Cell phones · Public phone system (FAA Order 7210.3 Section 3, 3-3-1. SERVICE "F" COMMUNICATIONS Facility AT managers shall establish procedures to provide interim communications in the event that local or long-line standard Service "F" fail. These shall include the use of telephone conference circuits and the use of airline or other facilities;3-3-2. TELEPHONE COMMUNICATIONS) Facilities periodically check available of communications with other facilities and would be aware of loss of communications. Procedures exist to transfer control to another facility in case of failure. (e.g. primarily redundancy: ARTCC to ARTCC and ARTCC to Command Center rely through third party) FAA Order 7210.3 Facility Operation and Administration; Section 3. Letters of Agreement (LOA) 4-3-1. LETTERS OF AGREEMENT ;4-3-2. APPROPRIATE SUBJECTS Examples of subjects of LOAs are: a. Between ARTCCs: 1. Radar handoff procedures.2. Interfacility coordination procedures.3. Delegation of responsibility for IFR control jurisdiction Procedures exist to have aircraft initiate transfer with receiving facility. (FAA Order 7110.65P 8-2-2 Transfer of Control and Communications).		
NAS Inter COMM-2	NAS Inter Facility Communication Capability Partially Unavailable – Ground (known)	1. Hardware failure 2. Software Failure 3. Insufficient capacity	4D	Controller needs to coordinate with a controller at another NAS facility (transfer of a flight outside of what is automated). Controller knows ahead of time or realizes when trying to contact another facility that there is a loss of all NAS voice and data communications to some other facility (including the receiving one) Since air-ground communication is still available the transferring ground facility would direct the aircrew to contact the receiving facility directly for transfer instructions. Slight reduction in ATC capability Slight increase in aircrew workload	SR-1000: 3.6.2A 1: The NAS shall provide direct-access voice communications connectivity between specialist in on ATC facility and designated specialist in another facility as shown in Table 3-1. The number of direct-access calls that are blocked because of saturation of equipment shall not exceed 1 in 1000 calls. Air-ground communication remains available Redundancy to prevent interruption – centers can talk to multiple facilities (2 or 3 facilities typical) and command center Required communication between facilities has been minimized; most transfers of control are done automatically Diverse entry points into facilities. (Communication Diversity Order 6000.36A) Procedure to switch to emergency operational AT procedures. (FAA Order 7210.3 Facility Operation and Administration Section 3 Letters of Agreement (LOA) 4-3-1 Letters of Agreement; g. Establish responsibilities for: 2. Providing emergency services).	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
					Procedure to switch to FAA-owned communications systems – FAATSAT transportable equip., RCL, portable air-ground radio.		
					Other facility can be reached be other means (Local Contingency Plan – FAA Order 7210.3 Facility 2-1-7 Air Traffic Service (ATS) Continuity a. Facilities shall develop and maintain current operational plans and procedures to provide continuity of required services during emergency conditions (e.g. power failures, fire, flood) b. Contingency plans).		
					· Relay through aircraft · Cell phones · Public phone system (FAA Order 7210.3 Section 3, 3-3-1. SERVICE "F" COMMUNICATIONS Facility AT managers shall establish procedures to provide interim communications in the event that local or long-line standard Service "F" fail. These shall include the use of telephone conference circuits and the use of airline or other facilities;3-3-2. TELEPHONE COMMUNICATIONS)		
					Facilities periodically check available of communications with other facilities and would be aware of loss of communications.		
					Procedures exist to transfer control to another facility in case of failure. (e.g. primarily redundancy: ARTCC to ARTCC and ARTCC to Command Center rely through third party) FAA Order 7210.3 Facility Operation and Administration; Section 3. Letters of Agreement (LOA) 4-3-1. LETTERS OF AGREEMENT ;4-3-2. APPROPRIATE SUBJECTS Examples of subjects of LOAs are: a. Between ARTCCs: 1. Radar handoff procedures.2. Interfacility coordination procedures.3. Delegation of responsibility for IFR control jurisdiction		
					Procedures exist to have aircraft initiate transfer with receiving facility. (FAA Order 7110.65P 8-2-2 Transfer of Control and Communications).		
NAS Inter COMM-3	*Covered in NAS Inter COMM-2; N/A*						
NAS Inter COMM-4	NAS interfacility communication fails while communicating with another NAS ATS facility	a. message (or part) does not make it to other NAS ATS facility b. response message (or part) from other NAS ATS facility does not make it back to initiator	2E	Controller needs to coordinate with a controller at another NAS facility (transfer of a flight outside of what is automated). Transfer of control is in progress between two facilities and NAS communication fails resulting in the aircraft having different transfer instructions that the receiving ground facility. Airspace is not protected since not in accord with ground information. Results in misleading information; where flight could have clearance from transferring controller that is different from clearance agreed to by receiving controller. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in	SR-1000: 3.6.2A 1: The NAS shall provide direct-access voice communications connectivity between specialist in on ATC facility and designated specialist in another facility as shown in Table 3-1. The number of direct-access calls that are blocked because of saturation of equipment shall not exceed 1 in 1000 calls. Air-ground communication remains available Redundancy to prevent interruption – centers can talk to multiple facilities (2 or 3 facilities typical) and command center Required communication between facilities has been minimized; most transfers of control are done automatically Diverse entry points into facilities. (Communication Diversity Order 6000.36A) Procedure to switch to emergency operational AT procedures. (FAA Order 7210.3 Facility Operation and Administration Section 3 Letters of Agreement (LOA) 4-3-1 Letters of	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload.	Agreement; g. Establish responsibilities for: 2. Providing emergency services). Procedure to switch to FAA-owned communications systems – FAATSAT transportable equip., RCL, portable air-ground radio. Other facility can be reached be other means (Local Contingency Plan – FAA Order 7210.3 Facility 2-1-7 Air Traffic Service (ATS) Continuity a. Facilities shall develop and maintain current operational plans and procedures to provide continuity of required services during emergency conditions (e.g. power failures, fire, flood) b. Contingency plans). · Relay through aircraft · Cell phones · Public phone system (FAA Order 7210.3 Section 3, 3-3-1. SERVICE "F" COMMUNICATIONS Facility AT managers shall establish procedures to provide interim communications in the event that local or long-line standard Service "F" fail. These shall include the use of telephone conference circuits and the use of airline or other facilities;3-3-2. TELEPHONE COMMUNICATIONS) Facilities periodically check available of communications with other facilities and would be aware of loss of communications. Procedures exist to transfer control to another facility in case of failure. (e.g. primarily redundancy: ARTCC to ARTCC and ARTCC to Command Center rely through third party) FAA Order 7210.3 Facility Operation and Administration; Section 3. Letters of Agreement (LOA) 4-3-1. LETTERS OF AGREEMENT ;4-3-2. APPROPRIATE SUBJECTS Examples of subjects of LOAs are: a. Between ARTCCs: 1. Radar handoff procedures.2. Interfacility coordination procedures.3. Delegation of responsibility for IFR control jurisdiction Procedures exist to have aircraft initiate transfer with receiving facility. (FAA Order 7110.65P 8-2-2 Transfer of Control and Communications).		
NAS Inter COMM -5	*NA: would do any required coordination one at a time and would be covered in NAS Inter Comm-4.*						
NAS Inter COMM-6	*NA*						
NAS Inter COMM-7	*NA*						
NAS Inter COMM-8	An interfacility affecting separation is sent to unintended recipient	Mis-delivered	5	**Case 1:** When calling another sector controller in another facility; the calling sector controller reaches an unintended controller (the wrong facility or the wrong controller with the other facility). (The controller correctly inputs the number). Once start talking would realize wrong controller; no effect. **Case 2:** Flight plan information goes to wrong facility and does not reach intended facility.	Interfacility communication requirements have been minimized due to automation of many functions Inter-facility data communications shall be provided with error detection and correction capabilities (NASSRS 3.6.3.A.11). FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				Increased controller workload; but well within normal duties.			
NAS Inter COMM-9	An interfacility message NOT affecting separation is sent to unintended recipient	Mis-delivered	5	**Case 1:** When calling another sector controller; the calling sector controller reaches an unintended controller (the wrong facility or the wrong controller with the other facility). (The controller correctly inputs the number). Once start talking would realize wrong controller; no effect. **Case 2:** Flow control information goes to wrong facility and does not reach intended facility. Increased controller workload; but well within normal duties.	Interfacility communication requirements have been minimized due to automation of many functions Inter-facility data communications shall be provided with error detection and correction capabilities (NASSRS 3.6.3.A.11) NAS systems digital circuits basic requirement to provide in excess of 99.9% error free seconds	*None*	
NAS Inter COMM-10	An interfacility affecting separation received too late or expired (applies to data link messages only)	Late delivery by communication system	5	Flight plan information does not arrive in sufficient time. Same effect as Case 2 for NAS Inter COMM-6 where the intended recipient did not receive the message.	FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace	*None*	
NAS Inter COMM-11	An interfacility NOT affecting separation received too late or expired (applies to data link messages only)	Late delivery by communication system	5	Flow control information does not arrive in sufficient time. Same as Case 2 for NAS Inter COMM-7 where the intended recipient did not receive the message.	None required	*None*	
NAS Inter COMM-12	An interfacility message affecting separation corrupted	The communication system corrupts the message	2E	Controller needs to coordinate with a controller at another NAS facility (transfer of a flight outside of what is automated). The message is corrupted, but credible Results in misleading information; where flight could have clearance from transferring controller that is different from clearance agreed to by receiving controller. This could result in a loss of separation (if the accepted corrupted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload.	Interfacility communication requirements have been minimized due to automation of many functions NAS-SR-1000 p3.6.2.A.3 Ground-Ground Interfacility Communications Connectivity 5) Clearly intelligible interfacility voice communications shall be provided. FTI Attachment J.1, FAA Telecommunications Services Description (FTSD): Voice Quality Mean Opinion Score (MOS) equal to or greater than 4.3. Inter-facility data communications shall be provided with error detection and correction capabilities (NASSRS 3.6.3.A.11). NAS systems digital circuits basic requirement to provide in excess of 99.9% error free seconds. Interfacility Data (IDAT) parity and checksum to reliably detect corruption of the message.	*None*	
NAS Inter COMM-13	An interfacility message NOT affecting separation corrupted	The communication system corrupts the message	5	One controller provides information to a controller in another facility that does not affect separation Due to the communication system the message is corrupted, but credible. At most there may be additional workload, due to a need to re-communicate message; but this is well within the normal controller workload	Interfacility communication requirements have been minimized due to automation of many functions NAS-SR-1000 p3.6.2.A.3 Ground-Ground Interfacility Communications Connectivity 5) Clearly intelligible interfacility voice communications shall be provided FTI Attachment J.1, FAA Telecommunications Services Description (FTSD): Voice Quality Mean Opinion Score (MOS) equal to or greater than 4.3	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
				No safety affect	Inter-facility data communications shall be provided with error detection and correction capabilities (NASSRS 3.6.3.A.11) NAS systems digital circuits basic requirement to provide in excess of 99.9% error free seconds		
NAS Inter COMM-14	An interfacility message affecting separation arrives out of sequence (data message only)	The communication delivers a second message before the first	5	Two messages arrive out of order that affect separation; when the order matters. This could apply to flight plan messages that have changed concerning a given flight.	FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	*None*	
NAS Inter COMM-15	An interfacility message NOT affecting separation arrives out of sequence (data message only)	The communication delivers a second message before the first	5	Two messages arrive out of order that do NOT affect separation; when the order matters. This could apply to flow control messages that have changed No safety affect	None required.	*None*	

F.6   NAS ATS-Other Government Agency Message Hazards

This section presents the 15 identified NAS communication hazards as they apply to messages exchanged between NAS ATS to Other Government Agency Message. Table D-6 contains the hazard analysis worksheet for the following functions:
- C.1.1.3.2.1 Transceive NAS ATS to Other Government Agency Message, and
- C.1.1.3.2.2 Transceive Other Government Agency to NAS Message

The system state leading to the worst credible effect (WCE) is the same for all NAS ATS to Other Government Agency hazards due to the NAS Communication System:
- HOST functional (automation working)
- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions

Table D-6: NAS ATS to Other Government Agency Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS-OGA COMM-1	NAS OGA Communication Capability Totally Unavailable - (known)	1. Hardware failure 2. Software Failure	2E	NAS ATS unable to communicate with Airport Authority due to NAS communication failure Airport Authority attempts to contact NAS ATC to advise of hazardous runway conditions. Whether or not the controller receives information from the Airport authority; controller is also responsible to assess runways conditions (looking out window; information from previously landing aircraft) In rare cases, controller may land aircraft, have incident.	Air-ground communication remains available ATC uses judgment whether or not to clear aircraft to land. (FAA Order 7110.65P 3-1-5. VEHICLES/EQUIPMENT/ PERSONNEL ON RUNWAYS) The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). OGA can be reached be other means: • Cell phones • Public phone system The NAS shall be capable of continuously broadcasting the latest approved aerodrome and terminal area conditions on communications media which can be accessed by aircraft in flight and on the ground. (NAS-SR-1000 3.3.3.B). Aeronautical information shall be continuously (24 hours a day) accessible to specialists. (NAS-SR-1000 3.1.2.B) Aeronautical information shall be continuously (24 hours a day) accessible to users upon request with or without the aid of specialists. (NAS-SR-1000 3.1.2.C). Aeronautical information shall be obtainable along a specified route, or in conjunction with specified locations or areas, or by reporting location. (NAS-SR-1000 3.1.2.D).	None	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS-OGA COMM-2	NAS OGA Communication Capability Partially Unavailable –Ground (known)	1. Hardware failure 2. Software Failure 3. Insufficient capacity	2E	NAS ATS unable to communicate with Airport Authority due to NAS communication failure

Airport Authority attempts to contact NAS ATC to advise of hazardous runway conditions.

Whether or not the controller receives information from the Airport authority; controller is also responsible to assess runways conditions (looking out window; information from previously landing aircraft)

In rare cases, controller may land aircraft, have incident. | Air-ground communication remains available

ATC uses judgment whether or not to clear aircraft to land. (FAA Order 7110.65P 3-1-5. VEHICLES/EQUIPMENT/ PERSONNEL ON RUNWAYS)

The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D)

Coordination of Communication requirements through Memorandum of Understanding (MOU) or local letter of agreement

OGA can be reached be other means:
• Cell phones
• Public phone system

The NAS shall be capable of continuously broadcasting the latest approved aerodrome and terminal area conditions on communications media which can be accessed by aircraft in flight and on the ground. (NAS-SR-1000 3.3.3.B).

Aeronautical information shall be continuously (24 hours a day) accessible to specialists. (NAS-SR-1000 3.1.2.B).

Aeronautical information shall be continuously (24 hours a day) accessible to users upon request with or without the aid of specialists. (NAS-SR-1000 3.1.2.C).

Aeronautical information shall be obtainable along a specified route, or in conjunction with specified locations or areas, or by reporting location. (NAS-SR-1000 3.1.2.D). | *None* | |
| NAS-OGA COMM-3 | *Covered in NAS OGA COMM 1 or 2, N/A* | | | | | | |

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS-OGA COMM-4	NAS OGA communication fails	1. message (or part) does not make it to recipient 2. response message (or part) does not make it back to initiator	2E	While communicating with Airport Authority communication fails concerning hazardous runway conditions such that controller is mis-informed as to which runway. Whether or not the controller receives information from the Airport authority; controller is also responsible to assess runways conditions (looking out window; information from previously landing aircraft) In rare cases, controller may land aircraft, have incident.	Air-ground communication remains available ATC uses judgment whether or not to clear aircraft to land. (FAA Order 7110.65P 3-1-5. VEHICLES/EQUIPMENT/ PERSONNEL ON RUNWAYS) The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D). Coordination of Communication requirements through MOU or local letter of agreement OGA can be reached be other means: • Cell phones • Public phone system The NAS shall be capable of continuously broadcasting the latest approved aerodrome and terminal area conditions on communications media which can be accessed by aircraft in flight and on the ground. (NAS-SR-1000 3.3.3.B). Aeronautical information shall be continuously (24 hours a day) accessible to specialists. (NAS-SR-1000 3.1.2.B). Aeronautical information shall be continuously (24 hours a day) accessible to users upon request with or without the aid of specialists. (NAS-SR-1000 3.1.2.C). Aeronautical information shall be obtainable along a specified route, or in conjunction with specified locations or areas, or by reporting location. (NAS-SR-1000 3.1.2.D).	*None*	
NAS-OGA COMM-5	*NA: would do any required coordination one at a time and would be covered in NAS OGA Comm-4, N/A.*						
NAS-OGA COMM-6	*NA*						
NAS-OGA COMM-7	*NA*						
NAS-OGA COMM-8	A message affecting separation is sent to unintended recipient	Mis-delivered	5	When calling OGA; the calling sector controller reaches an unintended recipient. (The controller correctly inputs the number). Once start talking would realize wrong number; so no effect	Coordination of Communication requirements through MOU or local letter of agreement	*None*	
NAS-OGA COMM-9	A message NOT affecting separation is sent to unintended recipient	Mis-delivered	5	When calling OGA; the calling sector controller reaches an unintended recipient. (The controller correctly inputs the number). Once start talking would realize wrong number; so no effect	Coordination of Communication requirements through MOU or local letter of agreement	*None*	
NAS-OGA COMM-10	A message affecting separation received too late or expired (applies to data link messages only)	*No plausible scenarios affecting could be envisioned; so NC*					
NAS-OGA COMM-11	A message NOT affecting separation received too late or expired (applies to data link messages only)	*No plausible scenarios affecting could be envisioned; so NC*					

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS-OGA COMM-12	A message affecting separation corrupted	The communication system corrupts the message	2E	While communicating with Airport Authority NAS communication corrupts message concerning hazardous runway conditions such that controller is mis-informed as to which runway. Whether or not the information is corrupted; controller is also responsible to assess runways conditions (looking out window; information from previously landing aircraft) In rare cases, controller may land aircraft, have incident.	Air-ground communication remains available ATC uses judgment whether or not to clear aircraft to land. (FAA Order 7110.65P 3-1-5. VEHICLES/EQUIPMENT/ PERSONNEL ON RUNWAYS) The NAS shall provide the specialist with an unobstructed view of the airport movement area. (NAS-SR-1000 3.2.11.D) OGA can be reached be other means: • Cell phones • Public phone system The NAS shall be capable of continuously broadcasting the latest approved aerodrome and terminal area conditions on communications media which can be accessed by aircraft in flight and on the ground. (NAS-SR-1000 3.3.3.B). Aeronautical information shall be continuously (24 hours a day) accessible to specialists. (NAS-SR-1000 3.1.2.B). Aeronautical information shall be continuously (24 hours a day) accessible to users upon request with or without the aid of specialists. (NAS-SR-1000 3.1.2.C). Aeronautical information shall be obtainable along a specified route, or in conjunction with specified locations or areas, or by reporting location. (NAS-SR-1000 3.1.2.D).	None	
NAS-OGA COMM-13	A message NOT affecting separation corrupted	The communication system corrupts the message	5	One of the controllers misinterprets (due to NAS communication corruption of message) No safety affect	None required	None	
NAS-OGA COMM-14	A message affecting separation arrives out of sequence (data only)	*No plausible scenarios affecting could be envisioned; so NC*					
NAS-OGA COMM-15	A message affecting NOT separation arrives out of sequence (data only)	*No plausible scenarios affecting could be envisioned; so NC*					

D.6 NAS ATS-Foreign ATS Message

This section presents the 15 identified NAS communication hazards as they apply to messages exchanged between NAS ATS to Foreign ATS. Table D-7 contains the hazard analysis worksheet for the following functions:

- C.1.1.3.2.3 Transceive NAS ATS to Foreign ATS Message, and
- C.1.1.3.2.4 Transceive Foreign ATS to NAS ATS Message

The system state leading to the worst credible effect (WCE) is the same for all NAS ATS to Foreign ATS hazards due to the NAS Communication System:

- HOST functional (automation working)
- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions

Table D-7: NAS ATS-Foreign ATS Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Foreign ATS COMM-1	NAS OGA Communication Capability Totally Unavailable - (known)	1. Hardware failure 2. Software Failure	4D	Controller needs to coordinate boundary crossing of outgoing flight to foreign FIR

Controller knows ahead of time or realizes when trying to contact Foreign ATC that there is complete loss of all NAS voice and data communications to foreign FIR.

Since air-ground communication is still available the transferring facility would direct the aircrew to contact the receiving facility directly for transfer instructions.

Slight reduction in ATC capability

Slight increase in aircrew workload | Air-ground communication remains available

Real-time required communication between FIRs has been minimized; most transfers can be done sufficiently in advance (FAA Order 7110.65P Section 8-2-1 Coordination)

Coordination of Communication requirements through MOU or local letter of agreement

Foreign ATC can be reached be other means:
- Relay through aircraft
- Cell phones
- Public phone system

Procedure exist to transfer control to another facility in case of failure

Procedures exist to have aircraft initiate transfer with receiving facility. (FAA Order 7110.65P 8-2-2 Transfer of Control and Communications) | *None* | |

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Foreign ATS COMM-2	NAS OGA Communication Capability Partially Unavailable –Ground (known)	1. Hardware failure 2. Software Failure 3. Insufficient capacity	**4D**	Controller needs to coordinate boundary crossing of flight with foreign FIR Controller knows ahead of time or realizes when trying to contact Foreign ATC that there is complete loss of all NAS voice and data communications to foreign FIR. Since air-ground communication is still available the transferring facility would direct the aircrew to contact the receiving facility directly for transfer instructions. Slight reduction in ATC capability Slight increase in aircrew workload	Air-ground communication remains available Real-time required communication between facilities has been minimized; most transfers can be done sufficiently in advance Coordination of Communication requirements through MOU or local letter of agreement Foreign ATC can be reached be other means: • Relay through aircraft • Cell phones • Public phone system Procedure exist to transfer control to another facility in case of failure Procedures exist to have aircraft initiate transfer with receiving facility. (FAA Order 7110.65P 8-2-2 Transfer of Control and Communications)	*None*	
NAS Foreign ATS COMM -3	*Covered in NAS OGA COMM-1 or- 2 so N/A*						

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Foreign ATS COMM -4	NAS OGA communication fails	1. message (or part) does not make it to recipient 2. response message (or part) does not make it back to initiator	2E	Controller needs to coordinate boundary crossing of flight with foreign FIR Coordination is in progress and NAS communication fails resulting in the aircraft having different transfer instructions that the receiving facility. Airspace is not protected since not in accord with ground information. Results in misleading information; where flight could have clearance from transferring controller that is different from clearance agreed by receiving controller. This could result in a loss of separation (if the accepted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload.	Air-ground communication remains available Real-time required communication between facilities has been minimized; most transfers can be done sufficiently in advance This is a two-way exchange; usually getting cut-off etc. would be detected by one or both parties and coordination would be attempted again; it would be rare for the failure to go undetected. (FAA Order 7110.65P 8-2-3 ATC Services Interfacility Data Communications) Procedures exist to transfer control to another facility in case of failure. (e.g. primarily redundancy: ARTCC to ARTCC and ARTCC to Command Center rely through third party) FAA Order 7210.3 Facility Operation and Administration; Section 3. Letters of Agreement (LOA) 4-3-1. LETTERS OF AGREEMENT ;4-3-2. APPROPRIATE SUBJECTS Examples of subjects of LOAs are: a. Between ARTCCs: 1. Radar handoff procedures.2. Interfacility coordination procedures.3. Delegation of responsibility for IFR control jurisdiction Procedures exist to have aircraft initiate transfer with receiving facility. (FAA Order 7110.65P 8-2-2 Transfer of Control and Communications) Receiving controller would have automation and visual alert to detect: - Aircraft positions - Out-of-conformance - Potential conflict Other facility can be reached be other means (Local Contingency Plan – FAA Order 7210.3 Facility 2-1-7 Air Traffic Service (ATS) Continuity a. Facilities shall develop and maintain current operational plans and procedures to provide continuity of required services during emergency conditions (e.g. power failures, fire, flood) b. Contingency plans). · Relay through aircraft · Cell phones · Public phone system (FAA Order 7210.3 Section 3, 3-3-1. SERVICE "F" COMMUNICATIONS Facility AT managers shall establish procedures to provide interim communications in the event that local or long-line standard Service "F" fail. These shall include the use of telephone conference circuits and the use of airline or other facilities;3-3-2. TELEPHONE COMMUNICATIONS) Current separation standards. (FAA order 7110.65) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Foreign ATS COMM-5	*NA: would do any required coordination one at a time and would be covered in NAS Foreign ATS Comm-4, N/A*						
NAS Foreign ATS COMM-6	*NA*						
NAS Foreign ATS COMM-7	*NA*						
NAS Foreign ATS COMM-8	A message affecting separation is sent to unintended recipient	Mis-delivered	5	Boundary crossing coordination: **Voice:** When calling Foreign ATS; the calling controller reaches an unintended recipient or receives "wrong number" call from Foreign ATS. (The controller correctly inputs the number). Once start talking would realize wrong number; so no effect **Data:** the unintended recipient of a message would discard message and possibly inform the sender and situation could be rectified. When the sender is not notified of mis-delivery, then recipient does not receive coordination message. However receiving FIR has flight plan and would initiate coordination form his side. Perhaps slight increase in workload but well within normal duties.	Boundary Coordination Times are agreed by Memorandum of Understanding between FIRs. (FAA Order 7110.65P 8-2-2) Receiving ground system has flight plan. (FAA Order 7110.65P 8-2-1 a) Receiving ground system would initiate coordination/transfer. (FAA Order 7110.65P 8-2-2)	*None*	
NAS Foreign ATS COMM-9	A message NOT affecting separation is sent to unintended recipient	Mis-delivered	5	**Voice:** When calling Foreign ATS; the calling controller reaches an unintended recipient or receives "wrong number" call from Foreign ATS. (The controller correctly inputs the number). Once start talking would realize wrong number; so no effect **Data:** the unintended recipient of a message would discard message and possibly inform the sender and situation could be rectified. When the sender is not notified of mis-delivery, then recipient does not receive message. Since the message does not affect separation at most an inconvenience. Perhaps slight increase in workload if sender realizes message was not received and resends; but well within normal duties.		*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Foreign ATS COMM -10	A message affecting separation received too late or expired (applies only to data link)	Communication system delays message	5	Receiving FIR has flight plan and would initiate coordination form his side when expected message did not arrive in time. Perhaps slight increase in workload but well within normal duties.	Coordination of Communication requirements through MOU or local letter of agreement Boundary Coordination Times are agreed by Memorandum of Understanding between FIRs. (FAA Order 7110.65P 8-2-2) Receiving ground system has flight plan. (FAA Order 7110.65P 8-2-1 a) Receiving ground system would initiate coordination/transfer. (FAA Order 7110.65P 8-2-2)	*None*	
NAS Foreign ATS COMM-11	A message NOT affecting separation received too late or expired (applies only to data link)	Communication system delays message	5	Nuisance at most.	None required	*None*	
NAS Foreign ATS COMM-12	A message affecting separation corrupted (undetected)	The communication system corrupts the message	2E	**Voice:** One of the controllers misinterprets (due to NAS communication corruption of message) the other resulting in transferring of a flight with unexpected position (altitude; speed etc) **Data:** Communication system credibly corrupts message such that resulting in transferring of a flight with unexpected position (altitude; speed etc) Airspace is not protected since not in accord with ground information. Results in misleading information; where flight could have clearance from transferring controller that is different from clearance agreed by receiving controller. This could result in a loss of separation (if the accepted clearance converges with other aircraft clearances) The loss of separation could result in large reductions in safety margins Resolving the situation could also result in significantly increased ATC workload due to having to move several aircraft to re-establish or maintain separations Resolving the loss of separation could cause time critical aircrew decisions and excessively increased workload.	Air-ground communication remains available Real-time required communication between facilities has been minimized; most transfers can be done sufficiently in advance This is a two-way exchange; usually getting cut-off etc. would be detected by one or both parties and coordination would be attempted again; it would be rare for the failure to go undetected. (FAA Order 7110.65P 8-2-3 ATC Services Interfacility Data Communications) Receiving controller would have automation and visual alert to detect: - Aircraft positions - Out-of-conformance - Potential conflict Current separation standards. (FAA order 7110.65) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*None*	
NAS Foreign ATS COMM-13	A message NOT affecting separation corrupted (undetected)	The communication system corrupts the message	5	One controller provides information to a controller in another FIR that does not affect separation Due to the communication system the message is corrupted, but credible. At most there may be additional workload, due to a need to re-communicate message; but this is well within the normal controller workload No safety affect	None required	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS Foreign ATS COMM-14	A message affecting separation arrives out of sequence (only data message)	The communication delivers a second message before the first	4D	Two messages arrive out of order that affect separation; when the order matters. This could apply to boundary coordination message Since message is time stamped and sequenced, controller can detect out-of order. At most an increase in workload.	ICAO format boundary coordination messages are tagged and time stamped.	*None*	
NAS Foreign ATS COMM-15	A message NOT affecting separation arrives out of sequence (only data message)	The communication delivers a second message before the first	5	Two messages arrive out of order that do NOT affect separation; when the order matters. No safety affect	*None required*	*None*	

D.7 NAS ATS – Non-ATS or Non-OAG Message

This section presents the 15 identified NAS communication hazards as they apply to messages exchanged between NAS ATS to Non- ATS or Non-OAG (e.g., AOC). Table D-8 contains the hazard analysis worksheet for the following functions:

- C.1.1.3.2.5 Transceive NAS ATS to Non- ATS or Non-OAG Message, and
- C.1.1.3.2.6 Transceive Non- ATS or Non-OAG to NAS ATS Message

The system state leading to the worst credible effect (WCE) is the same for all NAS ATS to Non- ATS or Non-OAG hazards due to the NAS Communication System:

- HOST functional (automation working)
- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions

Table D-8: NAS ATS – Non-ATS or Non-OAG Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS non-ATS/OAG COMM-1	NAS OGA Communication Capability Totally Unavailable - (known)	1. Hardware failure 2. Software Failure	5	ATC-AOC cannot communicate Flight plans or flight plan amendments do not reach ATC Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS non-ATS/OAG COMM-2	NAS OGA Communication Capability Partially Unavailable –Ground (known)	a. Hardware failure b. Software Failure c. Insufficient capacity	5	ATC-AOC cannot communicate Flight plans or flight plan amendments do not reach ATC Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	None	
NAS non-ATS/OAG COMM-3	*Covered in* NAS non-ATS/OAG COMM -1 or -2; N/A						
NAS non-ATS/OAG COMM-4	NAS OGA communication fails	1. message (or part) does not make it to recipient 2. response message (or part) does not make it back to initiator	5	ATC-AOC communication fails while in use. Flight plans or flight plan amendments reach ATC; very slim chance flight plan still credible if truncated. Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	None	
NAS non-ATS/OAG COMM-5	*N/A*						
NAS non-ATS/OAG COMM-6	*NA*						
NAS non-ATS/OAG COMM-7	*NA*						
NAS non-ATS/OAG COMM-8	*NA*						
NAS non-ATS/OAG COMM-9	A message NOT affecting separation is sent to unintended recipient	Mis-delivered	5	ATC-AOC communication is mis-delivered. Receiving ATC would be non-applicable and would probably discard flight plan ATC that should have received flight plan does not. Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	None	
NAS non-ATS/OAG COMM-10	*NA*						
NAS non-ATS/OAG COMM -11	A message NOT affecting separation received too late or expired (applies only)to data link messages	Communication system delays message	5	ATC-AOC communication is delayed. ATC that does not received flight plan in time (equivalent to not receiving at all. Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	None	
NAS non-ATS/OAG COMM-12	*NA*						

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
NAS non-ATS/OAG COMM -13	A message NOT affecting separation corrupted	The communication system corrupts the message	5	ATC-AOC communication corrupts message. Flight plans or flight plan amendments reach ATC; very slim chance flight plan still credible if corrupted. Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	None	
NAS non-ATS/OAG COMM-14	NA						
NAS non-ATS/OAG COMM -15	A message NOT affecting separation arrives out of sequence (data message only)	The communication delivers a second message before the first	5	ATC-AOC communication corrupts message. Flight plans or flight plan amendments reach ATC out of order for a given flight; Aircrew would coordinate with ATC directly to receive clearance. Slight increase in aircrew workload	AOC-ATC messages cannot affect separation Air-ground communication remains available FAA Order 7110.65: IFR operations in any class of controlled airspace, a pilot must receive an appropriate ATC clearance prior to entering in the airspace.	None	

D.8   Aircraft to Aircraft Message

This section presents the 15 identified NAS communication hazards as they apply to ATS only messages exchanged between aircraft. Table D-9 contains the hazard analysis worksheet for the following functions:
- C.1.1.4.1.1 Transceive Airborne Aircraft to Airborne Aircraft ATS Message,
- C.1.1.4.2.1 Transceive Airborne Aircraft to On-ground Aircraft ATS Message,
- C.1.1.4.3.1 Transceive On-ground Aircraft to Airborne Aircraft ATS Message, and
- C.1.1.4.4.1 Transceive On-ground Aircraft to On-ground Aircraft ATS Message.

The system state leading to the worst credible effect (WCE) is the same for all Aircraft to aircraft hazards due to the NAS Communication System:
- Peak traffic conditions, and
- Instrument Meteorological Conditions (IMC) (see and avoid may not be possible), and
- Adverse weather conditions.

Note: This section considers second level failures; air-ground communication has already failed. When air-ground communication is available there are no hazards associated the aircraft-aircraft communications, since for ATC messages it is only a back-up

Table D-9: Aircraft to Aircraft Message Hazards Due to the NAS Communication System

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
Aircraft-Aircraft COMM-1	Aircraft-Aircraft Communication Capability Totally Unavailable (known)	1. Hardware failure 2. Software Failure 3. Insufficient capacity 4. RF Interference	4E	An aircraft cannot communicate with any other aircraft. When air-ground communication remains unaffected no hazard When air/ground communication is also lost, the aircraft must revert to standard no-com procedures. This could result in a loss of situational awareness. This should not result in a loss of separation.	Highly reliable systems. (AC-25-11 viii, Loss of all communication functions must be improbable; RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware; AC 25.1309-1A (*Air Transport*) SYSTEM DESIGN AND ANALYSIS; AC 23.1309-1C (*General Aviation*) EQUIPMENT, SYSTEMS, AND INSTALLATIONS IN PART 23 AIRPLANES;FAA FAR 121 requirement of "two means of communication for the intended operating environment") Standard operating procedures/pilot training Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) The NAS shall provide air-ground communications capabilities on a continuous basis. (NAS-SR-1000 3.6.1.E) The air-ground communication system shall comply with Critical services performance requirements: Availability – 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness*, Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a))	*None*	

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
Aircraft-Aircraft COMM-3	There is a total loss of communication between a single aircraft and all other aircraft	1. Hardware failure 2. Software Failure 3. Insufficient capacity 4. RF Interference	4D	An aircraft cannot communicate with any other aircraft. When air-ground communication remains unaffected then possible loss of situational awareness. The ground system is unable to communicate with an aircraft Any other aircraft the ground system asks cannot communicate with the given aircraft either (air-to-air relay) The aircraft reverts to standard no-com procedures. This could result in a loss of situational awareness. This should not result in a loss of separation.	Highly reliable systems. (AC-25-11 viii, Loss of all communication functions must be improbable; RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware; AC 25.1309-1A (*Air Transport*) SYSTEM DESIGN AND ANALYSIS; AC 23.1309-1C (*General Aviation*) EQUIPMENT, SYSTEMS, AND INSTALLATIONS IN PART 23 AIRPLANES;FAA FAR 121 requirement of "two means of communication for the intended operating environment") Standard operating procedures/pilot training Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) The NAS shall provide air-ground communications capabilities on a continuous basis. (NAS-SR-1000 3.6.1.E) The air-ground communication system shall comply with Critical services performance requirements: Availability – 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness*, Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)		

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
Aircraft-Aircraft COMM-4	Aircraft-aircraft communication fails	1. message (or part) does not make it to recipient 2. response message (or part) does not make it back to initiator	5	Communication fails between aircraft during communication. This would only have a safety effect if one aircraft was relaying a control instruction to another. The failure would still have to result in credible information. The aircrew of the receiving aircraft would confirm with the sending aircraft an failure would be noticed	Highly reliable systems. (AC-25-11 viii, Loss of all communication functions must be improbable; RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware; AC 25.1309-1A (*Air Transport*) SYSTEM DESIGN AND ANALYSIS; AC 23.1309-1C (*General Aviation*) EQUIPMENT, SYSTEMS, AND INSTALLATIONS IN PART 23 AIRPLANES;FAA FAR 121 requirement of "two means of communication for the intended operating environment") Standard operating procedures/pilot training Current separation standards. (FAA order 7110.65) The NAS shall provide air-ground communications capabilities on a continuous basis. (NAS-SR-1000 3.6.1.E) The air-ground communication system shall comply with Critical services performance requirements: Availability – 0.99999; No single point of failure of equipment, system, installation or facility shall cause loss of service to the user/specialist; The goal for a single loss of critical service to a user/specialist shall not exceed the duration of 6 seconds; The frequency of occurrence goal for any loss of service shall not exceed one per week. (NAS SR-1000 Section 3.8.1 *Operational Readiness*, Table 3.6.1). The NAS shall provide specialists with the capability to communicate with aircraft and vehicles in the airport movement area. Alternative forms of communication, such as visual signals transmitted by specialists, shall be provided in case normal air-ground voice and data communications fail or are unavailable. (NAS-SR-1000 3.2.11.F) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a))		
Aircraft-Aircraft COMM-5	*NA: would do any required coordination one at a time and would be covered in Aircraft-Aircraft COMM -4.*						
Aircraft-Aircraft COMM-6	*NA*						
Aircraft-Aircraft COMM-7	*NA*						

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
Aircraft-Aircraft COMM-8	A message affecting separation is sent to unintended recipient	1. Aircraft address corrupted 2. Mis-delivered	NC	This hazard would only come into play if an aircraft was relaying a clearance to another aircraft because the ground system was unable to contact that aircraft. Then the message being relayed by the aircraft must be sent to another aircraft, different from the one the ground intended. This could occur if the aircraft address is corrupted by the communication system during the NAS-aircraft communication. When the aircrew relaying the clearance contacts the (wrong) aircrew the mis-delivery would be detected. In the most unlikely chance the mis-delivery was not detected, then the relayed information has to be credible to the aircraft receiving the relay. The clearance contains the aircraft identification and this would not match the receiving aircraft. The contents of the clearance may not be applicable either. It would not be credible for this hazard to be undetected.	Standard no com procedures: Lost Communications procedures are prescribed. (Aeronautical Information Manual [AIM] 4-2-13) and Standard pilot procedures two-way radio communication failure Federal Aviation Regulations [FAR] 91.185) - Alternate control procedure (i.e., light gun instructions from towers) - "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 Current separation standards. (FAA order 7110.65) Procedures for maintaining clearance limits [definitions of clearance limit are FAA Pilot/Controller Glossary also the ICAO definition, ATC Clearance limit procedures are prescribed (7110.65, 4-6-1a Clearance Limit and FAR 91.185)] - ICAO PANS-RAC 4444: paragraph5.2.1.1 "No clearance shall be given to execute any maneuver that would reduce the spacing between two aircraft to less than the separation minimum Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) ATC procedures to transfer communication functions (after communication failure) to other positions/sectors/facilities are prescribed. (FAA Order 7110.65, 10-4-4) Possible alternative communications capabilities (e.g., cell phone, public telephone, AOC, satellite phone when available. relay - ATC can instruct some aircraft concerning those he can't get to - neighboring sector controller or facility - ATC able to transmit command clearances and receive pilot feedback via equipment other than com radio (e.g., transponder, navigation radio) (FAA Order 7110.65, 10-4-4, 3-2-1, FARs 91.215, 91.205) - Communications capability on emergency frequency TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	*None*	
Aircraft-Aircraft COMM-10	There is currently no data link between aircraft, *NA*						
Aircraft-Aircraft COMM-11	There is currently no data link between aircraft, *NA*						

Hazard #	Hazard Description	Causes	Risk/ RAC	Possible Effect	Existing Controls	Recommended Safety Requirements	Comments
Aircraft-Aircraft COMM -12	A message affecting separation corrupted (undetected)	The communication system corrupts the message	2E	This hazard would only come into play if an aircraft was relaying a clearance to another aircraft because the ground system was unable to contact that aircraft. The contents are corrupted when the controller provides the information to the relaying aircraft. Or When the aircrew relays the clearance contacts the contents are corrupted. The relayed information has to be credible to the aircraft receiving the relay. Other pilots could hear party line and call attention to problem It would not be highly unlikely for this hazard to be undetected.	Clearly intelligible air-ground voice communications shall be provided. (NAS-SR-1000 3.6.1.A) Procedures requiring Emphasis for Clarity (FAA Order 7110.65, 2-4-15) Procedures requiring "pilot acknowledgement/read back" when ATC issues clearances or instructions (FAA Order 7110.65, 2-4-3) Controllers can also determine aircraft action through surveillance; IDENT, observing radar screen. (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar) Air-to-air communications available, so another aircrew may hear an incorrect read-back and notify, and/or aircraft can announce intentions on party line Aircraft under radar and/or visual surveillance (except ocean and some ground environments in IMC). (FAA Order 7110.65P Effective Data August 4, 2005 Chapter 5 Radar and Visual p7-2-1.) The pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft. (FAA Order 7110.65 91.3(a)) "See and Avoid" procedures are prescribed. (Aeronautical Information Manual [AIM] 5-5-8 and Federal Aviation Regulations [FAR] 91.113 TCAS is available for Transport Category Aircraft. (FAR 14CFR Part 129.18)	None	
NAS Foreign ATS COMM -13	A message NOT affecting separation corrupted (undetected)	The communication system corrupts the message	5	No safety affect		None	
Aircraft-Aircraft COMM-14	There is currently no data link between aircraft, NA						
Aircraft-Aircraft COMM-15	There is currently no data link between aircraft, NA						

E   Appendix E: Security Categorization

This appendix provides the detailed security categorization of the existing NAS Communication System.

Security categorization is an initial step towards determination of security requirements for an information system. It involves determining the information types that the system will handle, and then assessing for each information type the potential impact due to the loss of the fundamental security services: confidentiality, integrity, and availability.

Security categorization aims to provide an initial indication of the importance of information security to the system, bounds the severity of threats to the system, and represents an opportunity for system owners and users to provide input concerning their security concerns that does not require extensive security expertise.

Security categorization is defined in NIST FIPS 199 [14]. See [14] for further discussion.

Note: Security categorization is performed before threat assessment, and thus provides an abstract assessment, independent of the threats and mitigations that exist.

The potential impact or severity of loss of confidentiality, integrity, and availability on each information type is ranked as "none", "low", "medium", "high – severe", or "high – catastrophic" using the severity definitions from Chapter 3.

The results of the security categorization of existing NAS Communication System are provided in Table E-1 below. The information types identified correspond to the functional breakdown from Appendix A.

Note 1: Information types do not distinguish between voice and data, because a particular exchange will have the same categorization regardless of whether it is realized by voice or data. (However, the current emphasis on restriction of data to strategic rather than tactical communications may be taken into account during subsequent steps of the security analysis.)

Note 2: MMC communications are not explicitly categorized because the impact of an attack on these communications would principally be felt in its indirect impact on other communications rather than in its impact on MMC communications themselves.

Table E-1: Security Categorization for the Existing NAS Communication System

Information Type (incl corresponding function ID)	Examples	Confidentiality	Integrity	Availability
C.1.1.1.1.1 Transceive ATS to Airborne Aircraft Message	• Clearances • Contact/Monitor Instructions • Check Stuck Microphone • Transfer Instructions • ATIS • SIGMETs • Hazardous Inflight Weather Advisory (2-6-2 FAA Order 7110.65P) • NAS Status Advisories • ADS Contract/Reports • Wake Turbulence (2-1-19-20 FAA Order 7110.65P) • Traffic Advisories (2-1-21 FAA Order 7110.65P) • Bird Activity (2-1-22 FAA Order 7110.65P) • PIREP (2-6-3 FAA Order 7110.65P) • Arrival RVR/RVV (2-8-2 FAA Order 7110.65P) • Low Level Wind Shear/Microburst Advisories (3-1-8 FAA Order 7110.65P)	Low	High – Severe	High – Severe
C.1.1.2.1.1 Transceive Airborne Aircraft to ATS Message	• Requests • Clearance/Instruction Responses • Emergency/Urgency Declarations • Contact Messages (providing frequency) • Weather Reports • ATIS Requests • Reports • Position Reports • Intent Data • PIREP (2-6-3 FAA Order 7110.65P)	Low	High – Severe	High – Severe

Information Type (incl corresponding function ID)	Examples	Confidentiality	Integrity	Availability
C.1.1.1.2.1 Transceive ATS to On-Ground Aircraft Message	• Clearances • Contact/Monitor Instructions • Check Stuck Microphone • Transfer Instructions • ATIS • SIGMETs • NAS Status Advisories • Taxi Instructions • RVR/RVV Departure info (2-8-2 FAA Order 7110.65P) • Low Level Wind Shear/Microburst Advisories (3-1-8 FAA Order 7110.65P)	Low	High – Severe	High – Severe
C.1.1.2.2.1 Transceive On-Ground Aircraft to ATS Message	• Requests • Clearance/Instruction Responses • Emergency/Urgency Declarations • Contact Messages (providing frequency) • ATIS Requests • Position Reports • Intent Data	Low	High – Severe	High – Severe
C.1.1.1.2.2 Transceive ATS to Vehicles Message	• Aircraft on Runway • Clearance Instructions • Operational Request (2-1-18 FAA Order 7110.65P) • Use of Active Runway (FAA Order 7110.65P) • Ground Traffic Movement (FAA Order 7110.65P) • Taxi and Ground Movement Operations (FAA Order 7110.65P)	Low	High – Severe	Medium
C.1.1.2.2.2 Transceive Vehicle to ATS Message	• Emergency vehicles tower responding to alert • Maintenance personnel crossing runway • Operational Request (2-1-18 FAA Order 7110.65P)	Low	High – Severe	Medium
C.1.1.3.1.1 Transceive Internal NAS ATS Intrafacility Message	• Handoff or pointout (cut corner of another sector) • Flow Control Instructions • Flight coordination • Runway Status (3-1-12 FAA Order 7110.65P)	Low	Medium	High – Severe

Information Type (incl corresponding function ID)	Examples	Confidentiality	Integrity	Availability
C.1.1.3.1.2 Transceive Internal NAS ATS Interfacility Message	• Flow Control Instructions • Flight coordination • Handoff (FAA Order 7110.65) • Operational Request (2-1-18 FAA Order 7110.65P) • Flight Plan Message	Low	Medium	High – Severe
C.1.1.3.2.1 Transceive NAS ATS to OGA Message	• DoD • Law Enforcement • National Weather Service: • NASA • RCC (Search and Rescue) • Homeland Security • State Department • Airport Authority • Fire Department	High – Severe	High – Severe	High – Severe
C.1.1.3.2.2 Transceive OGA to NAS ATS Message	• DoD • Law Enforcement • National Weather Service: • NASA • RCC (Search and Rescue) • Homeland Security • State Department • Airport Authority • Fire Department	High – Severe	High – Severe	High – Severe
C.1.1.3.2.3 Transceive NAS ATS to Foreign ATS Message	• Flight Plan Information 2-2-13 FAA Order 7110.65P) • Flight Coordination Information	Low	Medium	Medium
C.1.1.3.2.4 Transceive Foreign ATS to NAS ATS Message	• Flight Plan Information • Flight Coordination Information	Low	Medium	Medium
C.1.1.3.2.5 Transceive NAS ATS to non-NAS or non-OGA Message	AOC • Flight plan information • Flow control information • Emergency Declarations	Low	Medium	Medium
C.1.1.3.2.6 Transceive Non-NAS or non-OGA to NAS ATS Message	AOC • Emergency Declarations • Flight Plan Information • Flight Coordination Information • Schedule Information	Low	Medium	Medium

Information Type (incl corresponding function ID)	Examples	Confidentiality	Integrity	Availability
C.1.1.4.1.1 Transceive Airborne Aircraft to Airborne Aircraft Message	• Position Data (e.g., UNICOM) • Party-line • Relay messages • Intent information • Advisory Messages	Low	Low	Low
C.1.1.4.2.1 Transceive Airborne Aircraft to On-Ground Aircraft Message	ATC could ask an Airborne Aircraft to relay a message or request to an aircraft at the surface of a Satellite Airport if out of the RF LOS.	Low	Medium	Medium
C.1.1.4.3.1 Transceive On-Ground Aircraft to Airborne Aircraft Message	Surface Aircraft at Satellite airport sends a message to be relayed via airborne aircraft to ATC.	Low	Medium	Medium
C.1.1.4.2.2 Transceive Airborne Aircraft to Vehicles Message	No NAS ATS messages exchanged.	N/A	N/A	N/A
C.1.1.4.3.2 Transceive Vehicles to Airborne Aircraft Message	No NAS ATS messages exchanged.	N/A	N/A	N/A
C.1.1.4.4.1 Transceive On-Ground Aircraft to On-Ground Aircraft Message	Advisory Messages (e.g., If an aircraft notices structural or other anomaly such as fluid from another aircraft during taxi, the pilot could report his observations to the surface aircraft.)	Low	Medium	Low
C.1.1.4.4.2 Transceive On-Ground Aircraft to Vehicle Message	No NAS ATS messages exchanged.	N/A	N/A	N/A
C.1.1.4.4.3 Transceive Vehicle to On-Ground Aircraft Message	No NAS ATS messages exchanged.	N/A	N/A	N/A
C.1.1.4.4.4 Transceive Vehicle to Vehicle Message	No NAS ATS messages exchanged.	N/A	N/A	N/A

Two caveats apply to Table E-1.

First, the categories assigned are based on the known examples of messages for each function. Should additional messages be identified updates to the assigned categories may be required.

Second, security categorization focuses on the information types handled by the NAS Communication System. It does not consider attacks on the system, which target other connected systems. Attacks on other connected systems are often one of the major security concerns for NAS systems, and these concerns are likely to increase in the future as the ATC communications system increasingly becomes part of a larger FAA network, rather than the largely stand-alone network that it is today. Consideration of such attacks is deferred to the threat assessment provided in Appendix F.

F   Appendix F: Threat Analysis

This appendix documents the threat analysis of the existing NAS Communication System.

Note: Due to the sensitivity of the information contained in this appendix, it will not be widely distributed.   Contact the Security Team Lead for the ATC Communications Services Air-Ground Solution Development Group to request a copy of Appendix F.

G   Appendix G: Acronyms

AAC	Aeronautical Administration Communication
ABDIS	Automated Data Interchange System Service B
ACCT	Accounting Records
ACM	Airport Certification Manual
ADDA	Administrative Data
ADSY	Administrative Equipment Systems
ADVO	Administrative Voice
AFS	Aeronautical Fixed Services
AFTN	Aeronautical Fixed Telecommunication Network
AIM	Aeronautical Information Manual
AM(R)S	Aeronautical Mobile (Route) Service
AMCS	Aeronautical Mobile Communications Service
AMHS	Automated Message Handling System
AMSC	Satellite Telephone Network
ANICS	Alaskan NAS Interfacility Communications System
ANS	Automated Notification System
AOC	Airline Operational Control
AOZ	Free Flight
AR	Air Traffic
ARA	Research and Acquisitions
ARCTR	FAA Aeronautical Center or Academy
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ATC	Air Traffic Control
ATCSCC	Air Traffic Control System Command Center
ATCT	Air Traffic Control Tower
ATIS	Automated Terminal Information Service
ATN	Aeronautical Telecommunications Network
ATO	Air Traffic Organization
ATO-E	En-Route and Oceanic Services
ATO-W	Technical Operations Services
ATS	Air Traffic Services
AVS	Regulation and Certification Service
BRITE	Bright Radar Indicator Tower Equipment
BUEC	Backup Emergency Communication
BWM	Bandwidth Manager
C3	Command and Control Communications
CCCC	Emergency Command & Control Communications System
CERAP	Center Radar Approach Centers
CFR	Code of Federal Regulations
CONUS	Contiguous United States
COTS	Commercial Off The Shelf
CPDLC	Controller Pilot Data Link Communication
CST	Communications Support Teams
DBRITE	Digital Bright Radar Indicator Tower Equipment
DIP	Drop and Insert Point
DMM	Data Multiplexing Network
DMS	Defense Messaging System
DoD	Department of Defense

DoS	Denial-of-Service
DOT	Department of Transportation
ECOM	En Route Communications
EVCS	Emergency Voice Communications System
FAA	Federal Aviation Administration
FAATSAT	FAA Telecommunications Satellite
FAR	Federal Aviation Regulations
FCS-ISSA	Future Communications System – Information Systems Security Architecture
FIPS	Federal Information Processing Standards
FIR	Flight Information Regions
FISMA	Federal Information Security Management Act
FTI	Federal Telecommunications Infrastructure
FTS	Federal Telecommunications Service
FTSD	FAA Telecommunications Services Description
GSA	General Services Administration
HF	High Frequency
HF/SSB	High Frequency/Single Side Band
ICAO	International Civil Aviation Organization
IDAT	Interfacility Data
IMC	Instrument Meteorological Conditions
ISS	Information System Security
LDRCL	Low Density Radio Communications Link
LINCS	Lease Interfacility NAS Communications System
LOS	Line of Site
MDR	Multimode Digital Radio
MEVA	Mejoras al Enlace de Voz del ATS
MISC	Miscellaneous & ACCT: Accounting
MMC	Maintenance Monitoring and Control
MOU	Memorandum of Understanding
MSN	Message Switched Network
NADIN	National Airspace Data Interchange Network
NARACS	National Radio Communications System
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NIMS	NAS Infrastructure Management System
NIST	National Institute of Standards and Technology
NOTAM	Notice to Airmen
NWS	National Weather Service
OGA	Other Government Agency
OSHA	Occupational Safety Hazards Administration
PANS-RAC	Procedures for Air Navigation Services - Rules of the Air and Air Traffic Service
PCM	Pulse Code Modulation
PIREP	Pilot Report
PP	Protection Profiles
PSTN	Public Switched Telecommunications Network
RAC	Risk Analysis Code
RCAG	Remote Communications Air/Ground
RCAG	Remote Communication Air/Ground
RCC	Rescue Coordination Center
RCCC	Regional Communications Control Centers
RCL	Radio Communications Link
RCOM/C3	NAS Recovery Communications: FAA Command and Control

	Communications
RF	Radio Frequency
RML	Radar Microwave Link
RVR	Runway Visual Range
SAFEE	Security of Aircraft in the Future European Environment
SCAP	Security Certification and Authorization Package
SCS	Secure Conferencing System
SIGMETs	Significant Meteorological Information
SMS	Safety Management System
SP	Special Publication
SR	System Requirements
SRM	Safety Risk Management
SRS	System Requirements Specification
SSMP	System Safety Management Program
SSTF	Safety and Security Task Force
STE	Secure Telephone Equipment
SVF	Interphone Service F (D)
T1MUX	time division
TCAS	Traffic Alert and Collision Avoidance System
TCOM	Terminal Communications
TML	Television Microwave Link
TRACON	Terminal Radar Approach Control
U.S.	United States
VHF	Very High Frequency
VHF/FM	Very High Frequency/Frequency Modulated
WAFC	World Area Forecast Center
WAFS	World Area Forecast System
WAN	Wide Area Network
WCE	Worst Credible Effect

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I Appendix I: SSTF Members, Organization, and Contact Information

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